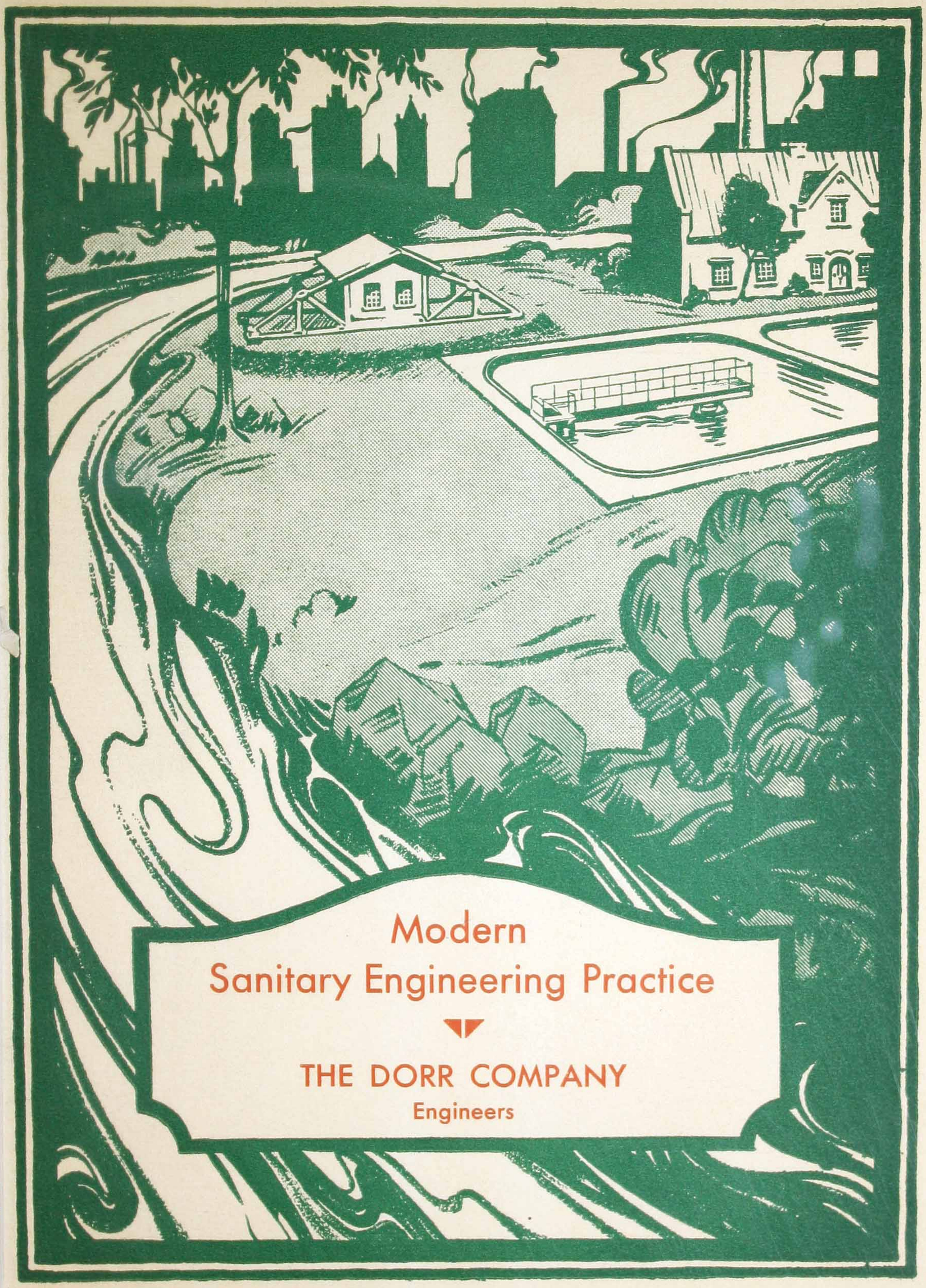

Modern Sanitary Engineering Practice

THE DORR COMPANY

Engineers

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MODERN SANITARY ENGINEERING PRACTICE

The Applications of Dorr Equipment to Modern Sewage Treatment and Water Purification Plants

DORRCO

Bulletin No. 6001

THE DORR COMPANY

247 PARK AVENUE

NEW YORK

For list of Offices, Associated Companies and Representatives see back cover

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FOREWORD

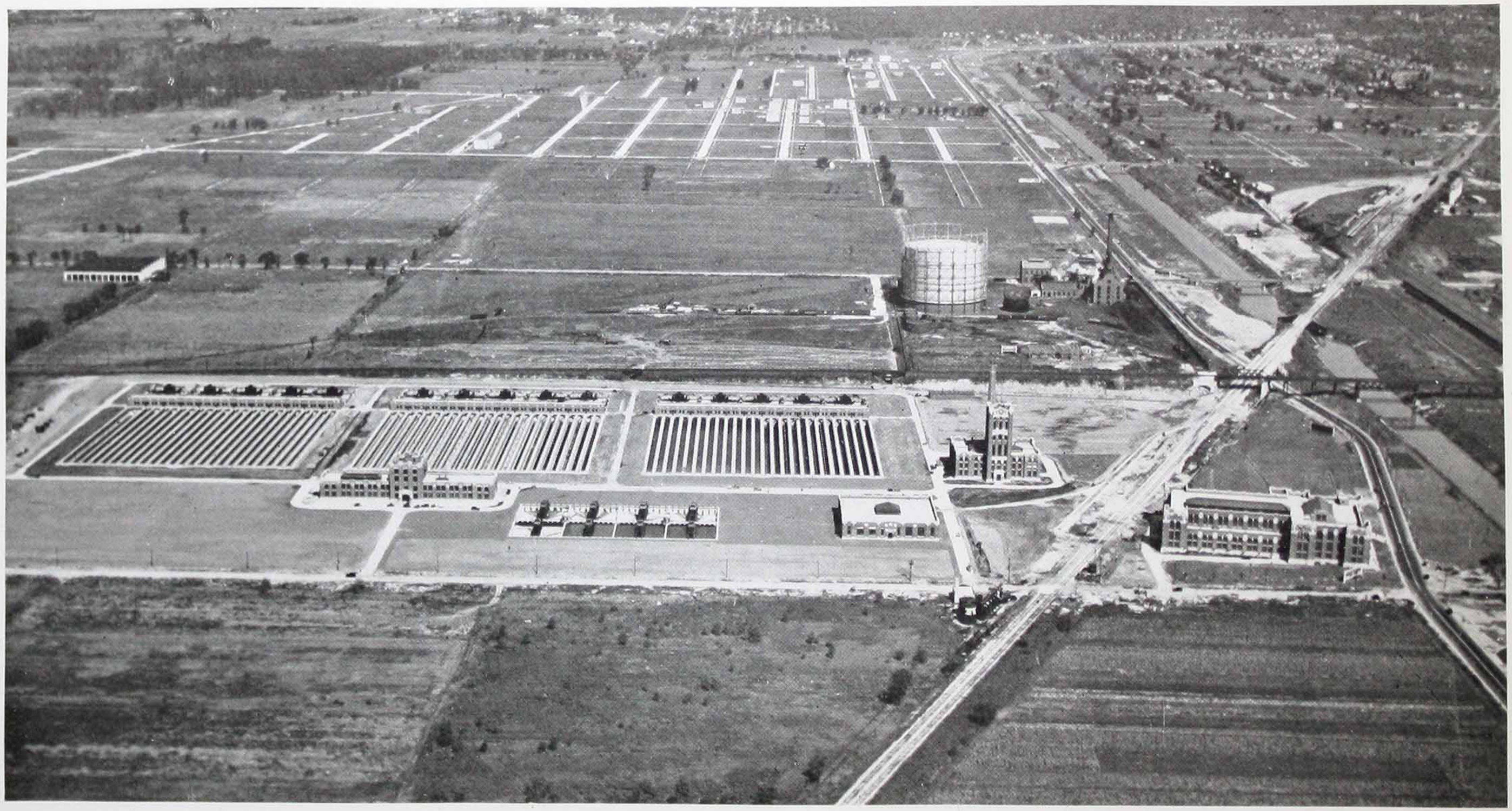
THIS booklet discusses in a general way the applications of Dorr Equipment to various types of sanitary engineering problems. Such problems are, for convenience, divided into three classes:

Those relating to the treatment of municipal sewage, described on pages 5 to 17.

Those relating to water purification or treatment, described on pages 18 to 22.

Those relating to the treatment and disposal of industrial wastes, described on pages 23 and 24.

Obviously, in a booklet of this nature, complete and detailed descriptions of sanitary engineering processes and practice, and of every specific application of Dorr Equipment, cannot be included. Each individual problem will naturally be governed by local conditions. However, the general discussions of the various fundamental operations involved will serve to show how Dorr Equipment is being used to promote efficiency and eliminate laborious manual operations in these three main classes of sanitary engineering work.



North Side sewage treatment plant, Sanitary District of Chicago. In this plant, which is the largest activated sludge plant in the world, eight Dorr Clarifiers are operated as pre-sedimentation units, and thirty Dorr Clarifiers are used for sedimentation after aeration. The plant has a capacity of 275 million gallons per day.

Introduction

THE DORR COMPANY has devoted years of study to that specialized branch of technology which involves the handling or treatment of liquid-solid mixtures. This field embraces such operations as agitation and mixing, classification, clarification, dewatering, screening, pumping, washing, and like operations.

In the metallurgical field Dorr Equipment is looked upon as standard and the Company's work has contributed in no small measure to the rapid advances in improved methods of concentrating ores; in the chemical field, Dorr machines and methods have been responsible for converting many wasteful, batch manufacturing processes into smooth, continuous operations; in the field of Sanitary Engineering, the Dorr Company has pioneered with the development of mechanical means of performing fundamental operations found in almost all types of sewage and water treatment plants, with the result that the inefficiencies and uncertainties of old methods are avoided. Today, Dorr Equipment is in operation in over 250 sewage and water treatment plants, scattered from Cairo, Egypt to Wahiawa, Hawaii, and from Edmonton, Alberta to Cape Town, South Africa.

Screening, grit removal, sedimentation, sludge digestion, mixing, sludge pumping, are some of the chief operations to which Dorr Equipment is adapted.

The Treatment of Municipal Sewage

Introduction

Efficient and adequate methods of sewage treatment, particularly in the more congested centers of population, are now generally recognized as being absolutely essential to the protection of human health, the preservation of fish life, and the prevention of nuisance to the nose and eye. In the United States and Canada, the large areas and numerous watercourses, and proportionately widely scattered population, caused this important subject to be more or less neglected until comparatively recent years; but, in densely-populated countries, such as England, sewage treatment methods have been the subject of study for almost a century.

During this time, there have naturally been many changes in the theory and practice of sewage treatment methods. Today, it is agreed that it is possible to procure any degree of purification required, the particular method of treatment selected being dependent on local conditions.

Usually the treated sewage flows into creeks, rivers, lakes, or the ocean, and the volume of the body of water ultimately receiving the sewage frequently determines the degree of treatment necessary. Where the stream or body of water into which the sewage flows is large, partial treatment, such as screening, will often suffice, although when the same stream or water is further used for domestic purposes, more intensive treatment must be provided

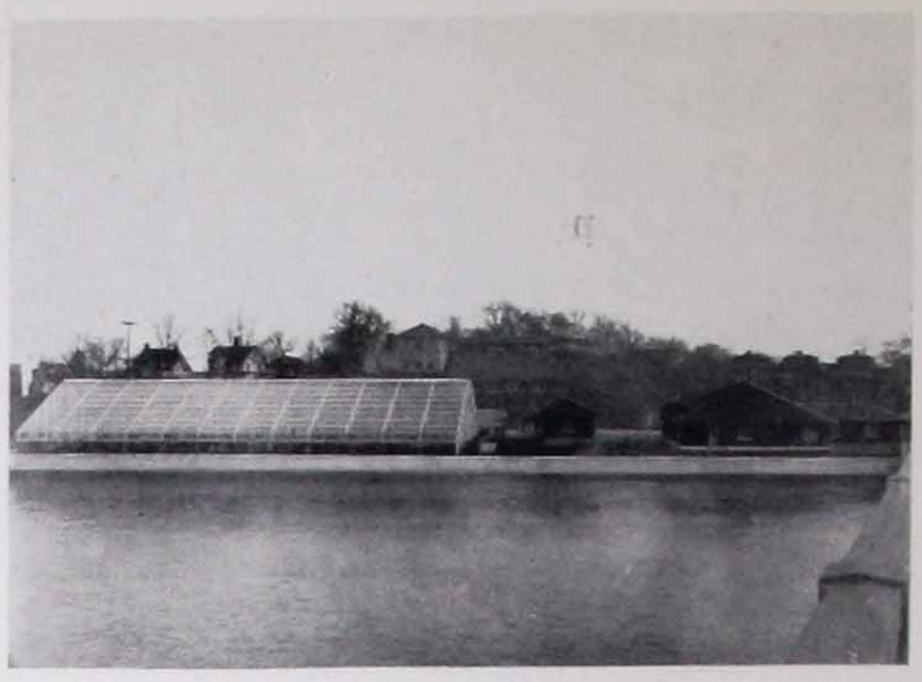
In districts where adequate bodies of water for receiving treated sewage are not available, a high degree of treatment is required, and in such cases the separate sludge digestion method, with or without trickling filters, or the activated sludge process, are generally resorted to.

Regardless of the process adopted and the degree of treatment required, there are certain fundamental operations which apply to all methods. The applications of Dorr Equipment to these operations are described below.

Coarse Screening

The first step in practically all sewage treatment plants is the removal of sticks, rags, paper and other large solids from the sewage. In the past, this has usually been accomplished by placing one or more plain rack screens, consisting of iron bars spaced apart from ½″ to 2½″ in the sewage channel. The bars are usually inclined in the channel at an angle of about 60°, and the opening between the bars will depend on local conditions and on the subsequent treatment employed. The large solids in the sewage are caught upon the bars and are periodically removed by hand raking. This raking process is objectionable and at many plants the labor involved is considerable. Moreover, the accumulation of solids on the bars causes loss of head and backing up of the sewage in the channel, and unless the bars are cleaned very frequently the action of the inflowing sewage forces quantities of coarse material through the bars. The solids deposited on the bars are also unsightly and, in many cases, malodorous and offensive.

This building houses the Dorrco Bar Screen and Dorr Detritor in the sewage treatment plant at Middletown, N. Y.



Sewage treatment plant at Red Bank, N. J. A Dorrco Bar Screen, two Dorr Clarifiers and a Dorr Digester, are in operation at this plant.

Several methods of eliminating the objectionable features of plain bar screens have been put forward. Cage screens, consisting of racks enclosed on three sides, and arranged so that they may be lifted out of the sewage for easier cleaning, have been installed in some plants. Such screens are usually arranged two in series and counterbalanced, so that one screen may be lifted out of the sewage and cleaned, while the other is in service. Most of the objections to the plain bar screen also hold true of the cage type, and the easier cleaning feature is offset by the cost of operation.

Realizing that a simple, mechanically-cleaned bar screen would fill a distinct need in the sanitary engineering field, the Dorr Company set about the development of such a machine. After much patient experimental work both in the laboratory and in the field, the Dorrco Bar Screen was introduced. This unit is simple to install and operate and offers the following advantages over other methods of coarse screening:

No odors or unsightly appearance, as the solids are removed from the bars as soon as deposited.

No loss of head or backing up of the sewage caused by accumulation of solids on the bars.

Greater capacity than plain bar screens of equal size and screen open-

ing, as there is no blinding caused by accumulated solids.

Maximum solids removal for a given opening, as the flow of sewage does not have a chance to force oversize material through the bars.

Screenings are handled mechanically.

No manual attention required except for oiling.

Requires practically no space outside of area of channel.

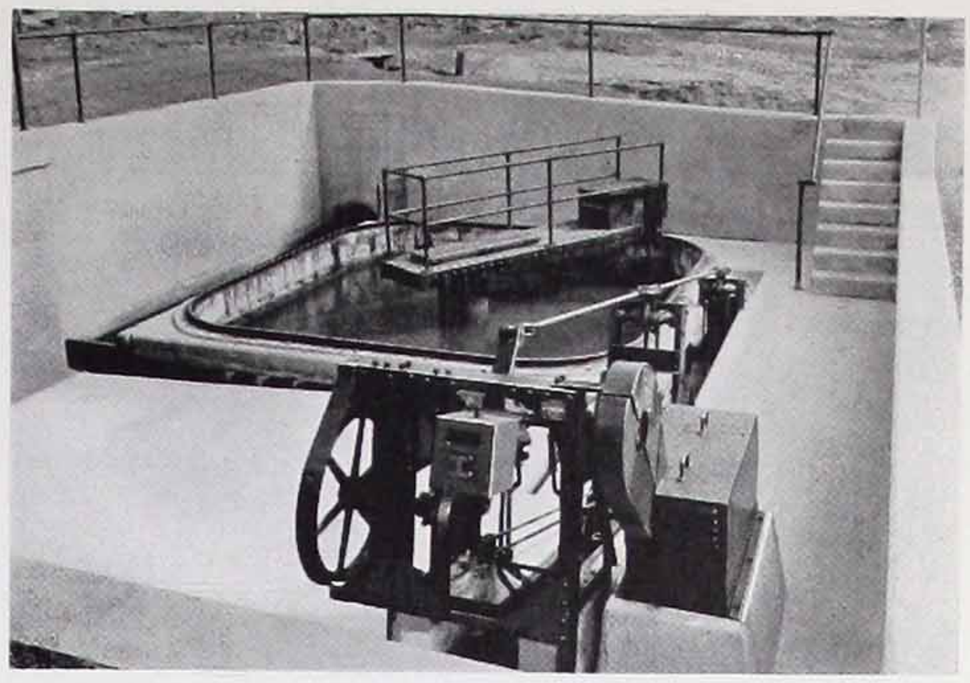
It is usually a comparatively simple matter to transform plain bar screens in existing plants into mechanically-cleaned units. The services of our Sanitary Engineering staff are available to investigate each problem and to prepare sketches showing how such a change can best be effected.

Grit Removal

In both the combined and separate sewerage systems a varying amount of grit is always present in the sewers. The greatest amounts are, of course, carried into the sewers during storm periods, when in the combined system, the sewers carry large quantities of grit, ashes, etc., washed down from the streets, and in the separate system, the sewers carrying the domestic sewage will be found to contain grit admitted through open manholes, from garage and industrial plant drainage, and by infiltration.

The handling and disposing of this grit at sewage treatment plants presents a problem. The comparatively coarse and inert material is detrimental to the proper functioning of the subsequent steps in all treatment processes, and some means of removing the grit has to be provided.

In the past the usual practice has been to install "grit chambers" which are enlarged channels where the velocity of the sewage flow is reduced sufficiently to allow the grit to settle out.



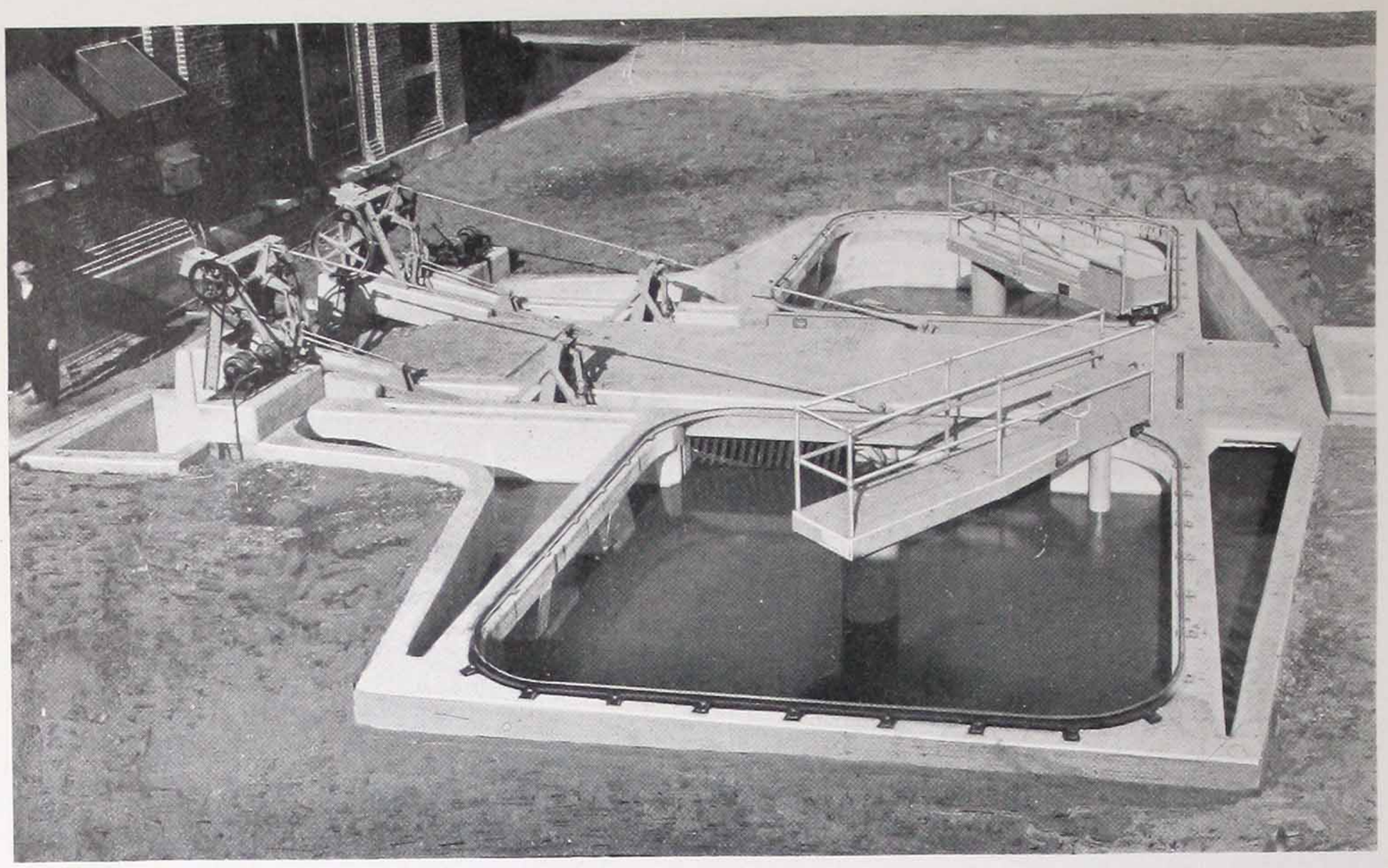
Dorr Detritor in the sewage treatment plant at High Point, N. C.

An attempt is made to design these grit chambers so that a uniform velocity of flow can be maintained, this velocity being the one at which the maximum amount of grit will settle without an excess of lighter, putrescible material.

Obviously this is a difficult problem, where the flow is constantly varying in volume as it is at a sewage treatment plant. Two or more grit chambers are provided and as the flow increases more channels are put into service, as required. As the grit chambers become filled up with accumulated solids they are emptied either by travelling bucket elevators, grab buckets, etc., or by by-passing the flow through another channel and cleaning out the unit which is out of service, by hand or mechanical means.

It has been found in practice, however, that no matter how carefully the grit chamber design has been worked out, an appreciable amount of putrescible organic material is always carried down with the heavier solids, and cleaning out grit chambers is usually an offensive and often odorous operation. The grit removed must always be washed before it can be used as fill or otherwise disposed of.

Moreover, if the cleaning operation is not performed frequently, the channels become filled up with solids, velocities increase, and the grit-chambers do no useful work.



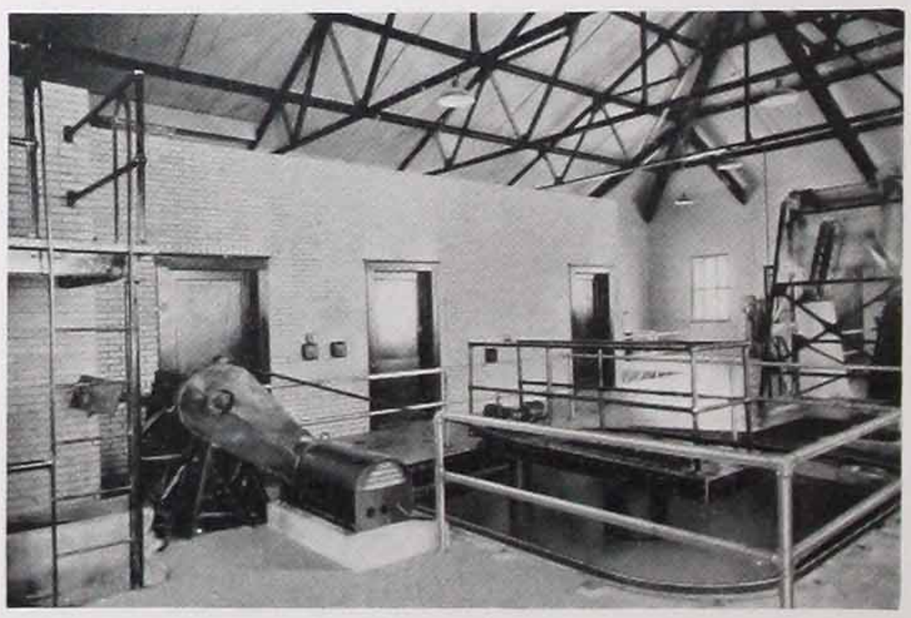
Two Dorr Detritors installed in the sewage treatment plant at Winston-Salem, N. C.

With these considerations in mind the Dorr Company undertook the development of a continuously cleaned mechanical grit chamber, which would eliminate the difficulties encountered with plain grit chamber operation. The result of the work was the introduction of the Dorr Detritor, which has solved in a simple manner, the grit handling problem in the many plants where it has been installed.

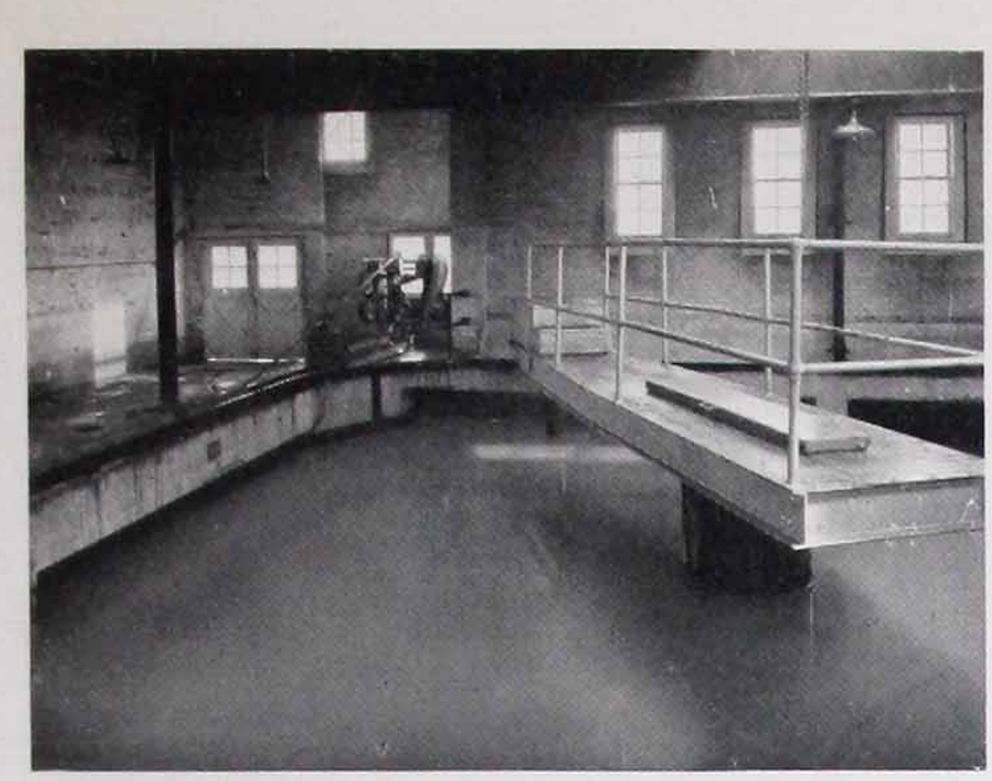
Briefly, the Detritor consists of two main parts—the settling compartment with collecting mechanism, and the washing compartment with cleaning and discharging mechanism. As the grit settles out in the settling compartment, the collecting mechanism sweeps it into the washing compartment, where it is picked up by the cleaning mechanism, is thoroughly washed, and is discharged in a clean, drained condition.

The most advantageous feature of a Dorr Detritor installation is the fact that the grit is removed from the sewage continuously and discharged in a clean condition, practically free from putrescible organic material. Tests have shown that the putrescible organics discharged with the grit will usually average less than 2.5%, while with plain grit chambers it runs anywhere from 10% to as high as 40%. The grit discharged from the Dorr Detritor can be used directly as fill without creating any odor nuisance.

Dorr Detritors are designed to handle large or small flows, and they can be installed in either new or existing treatment plants. They require no



A Dorr Detritor in the sewage treatment plant at Middletown, N. Y.



The Dorr Detritor in the separate sludge digestion plant at Aurora, Ill.

more space than old type grit chambers, no housing except over the drive unit, and the concrete work required will be less than that of the old type, as deep tanks are not necessary to provide space for grit storage. Duplicate units are not required except to increase capacity.

A Dorr Detritor installation simplifies design practice as the difficulty of endeavoring to maintain a uniform velocity in the grit chambers is eliminated. The unit is usually designed to handle the peak flow and should the velocity be reduced so that organics settle out with the grit, these organics will be automatically removed from the grit in the washing compartment.

Mechanically, the Detritor is a simple, rugged machine, designed for 24-hour-a-day service. All parts are slow moving, and even in the largest units the power requirements are extremely moderate. There are no submerged bearings, and repair costs will be low. Except for periodical oiling the machine requires no manual attendance.

To sum up, a Dorr Detritor installation will usually cost less than that of plain grit chambers of the same capacity, will improve the appearance of the plant, and will eliminate the offensive conditions so often found in plants using the ordinary grit collection channels.

A bulletin describing fully the construction and operation of the Detritor will be sent upon request.

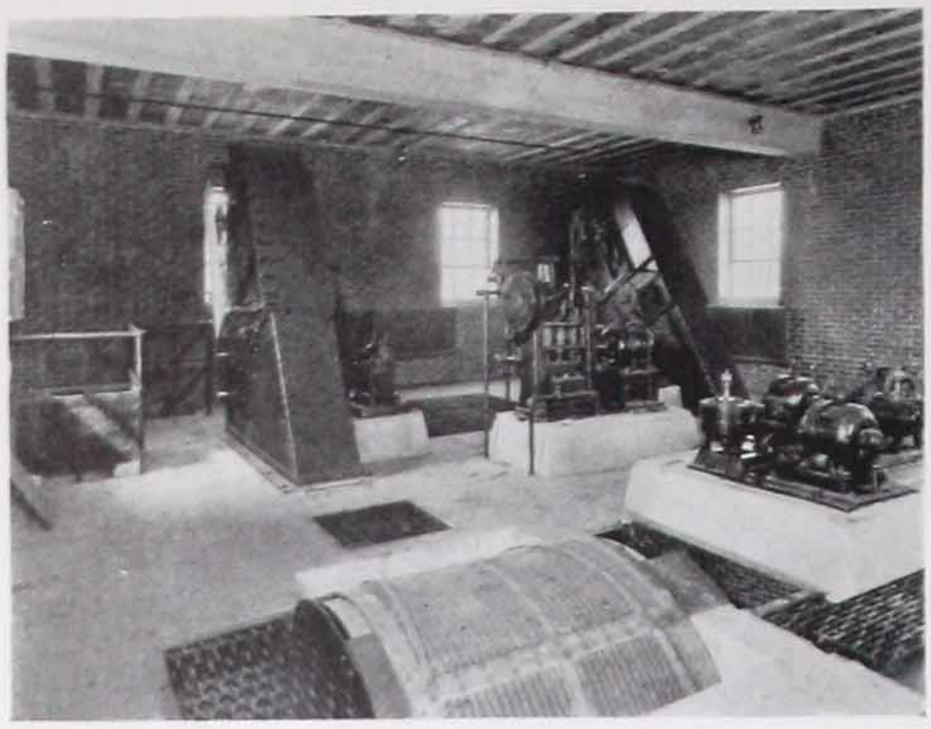
Fine Screening

Fine screens are used in sewage treatment either to remove objectionable floating solids from sewage which is then discharged into waterways without further treatment, or to decrease the quantity of solid matter carried in the sewage to further treatment steps.

The former method is quite often adopted at coastal cities where the removal of solids by fine screening is often the sole method of treatment. Los Angeles, Santa Barbara, Santa Cruz, Venice, Ventura, in California, Palm Beach, and Miami, Fla., Atlantic City, N. J., are some of the better known resort cities which are using Dorrco Screen units to protect their bathing beaches from pollution by obnoxious sewage solids. Where fine screens are used in connection with other treatment processes, they reduce the solids load on sedimentation, remove coarse solids which tend to settle to the bottom of aeration tanks in activated sludge plants, and in general, remove such solids as are apt to be troublesome in the subsequent processes. As discussed on page 12, there is a growing tendency to substitute preliminary sedimentation units for fine screens, when used ahead of more intensive treatment steps.

No matter for what purpose the fine screen is installed, to be satisfactory it

The Texas Ave. sewage screening plant is one of three plants operating Dorrco Screen Units at Atlantic City, N. J.



Dorrco Screen units in the sewage treatment plant at Allentown, Pa.

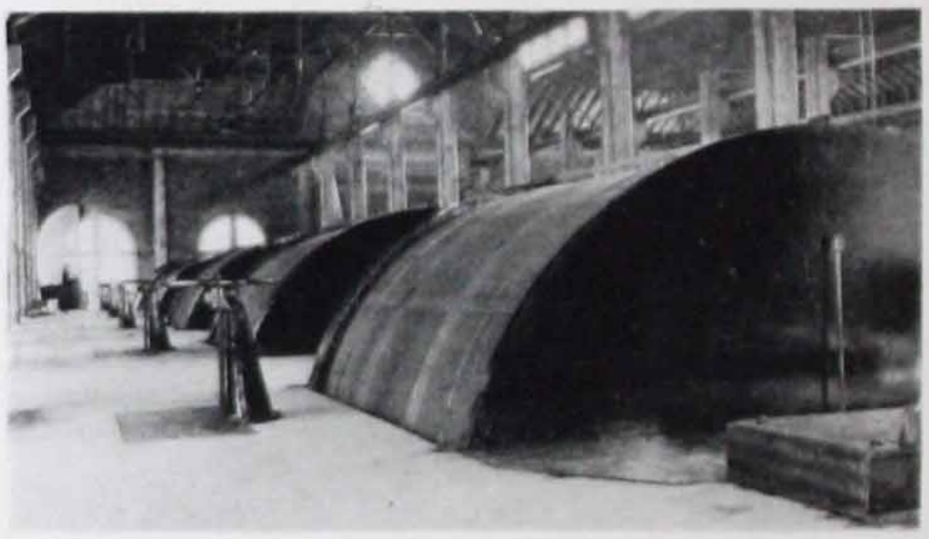
must effectively separate the solids from the liquid without clogging or blinding of the screening medium, and it should dewater the screened solids sufficiently to render them fit for final disposal.

The Dorrco Screen unit answers these two essential requirements admirably. The screen averages removals of 15-20% of the total suspended solids in the sewage and delivers the screenings with a moisture content of approximately 85%. In this condition the screenings can be conveniently handled, and may be carried by pneumatic ejectors to burial or incineration, or otherwise disposed of according to the local conditions.

This attractive sewage screening plant is located at Santa Cruz, California. Two Dorrco Screen units are installed.

The Dorrco Screen unit is of the rotary drum type, one end of the screen being closed and the other open for discharge of the screened sewage. The sewage flows against the outside of the drum, and the oversize solids are carried around the lower portion of the drum through about one-half a revolution. The unique "cascading" action of the sewage, produced by the rotary motion of the drum, discharges the solids into a screenings pit, whence they are removed by a bucket elevator.

Thus one of the outstanding features of the Screen is that it is absolutely self-cleaning, no scrapers, brushes or jets being required to assist discharge of solids. This feature minimizes wear on the screen plates and keeps down maintenance costs. The Screen is simple to install and operate, requiring manual attention only for oiling.



Five of the ten 14 ft. x 12 ft. Dorrco screens installed in the North Hyperion plant at Los Angeles. In the south plant eight Dorrco screen units are in operation.

The Dorrco Screen unit is quiet in operation and presents a very attractive appearance. In fact, the installations are usually so arranged that the sewage or screenings are not visible at all.

We will be glad to forward full information on the operation of the numerous Dorrco Screen units which are installed at prominent sewage treatment plants in the United States and Canada. The construction and operation of the Screen unit are described in detail in Bulletin 6291.

Sedimentation

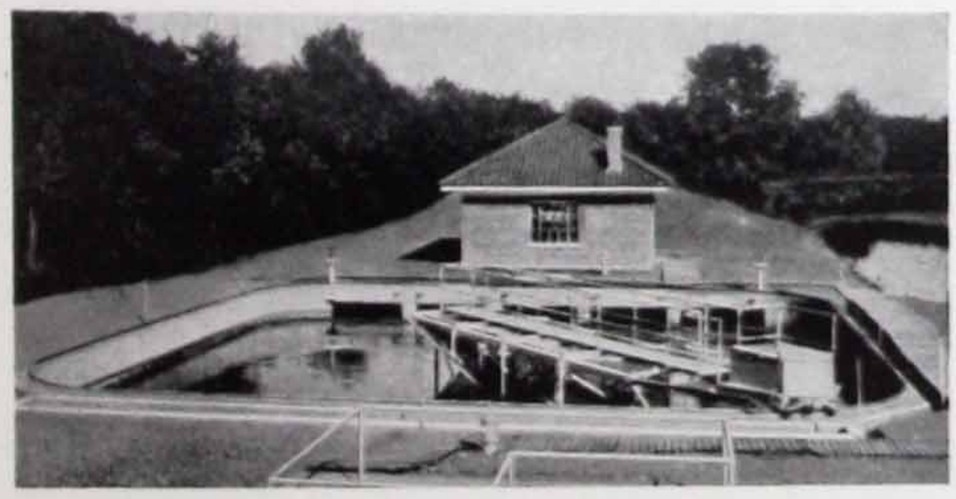
Sedimentation is the process of reducing the velocity of the flow of sewage sufficiently to allow settleable suspended solids to drop out. It is one of the most common operations in sanitary engineering work, and finds application at some point in the process, in all of the modern intensive sewage treatment methods.

Plain sedimentation, with disposal of the clarified effluent by dilution, has been used in the treatment of sewage for years.

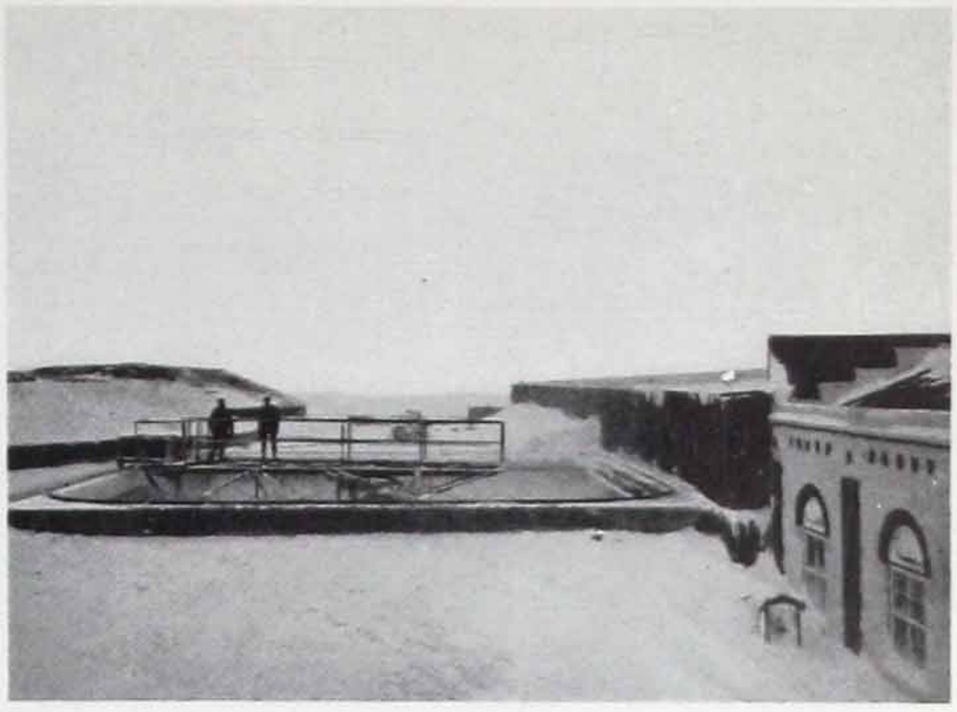
Sedimentation with or without chemical precipitation and followed by filtration is still used quite commonly in England. But, it was not until the rise of the activated sludge process a few years ago, that the need for more effective methods of performing sedimentation operations became a pressing problem.

Formerly, sedimentation was carried out either in tanks with hopper shaped bottoms from which the sludge was periodically withdrawn, or in plain flat-bottomed tanks which were shut down and cleaned out by hand, as required. Both these methods were inefficient, particularly the latter. In hopper-bottom tanks the sludge did not discharge cleanly from the sides of the hopper, with the result that septic action occurred and the surface of the tank became covered with a scum of floating, septic sludge.

This condition was unsightly and often caused offensive odors around the plant.



Dorr Traction Clarifier in the sewage treatment plant at Urbana-Champaign, Ill.

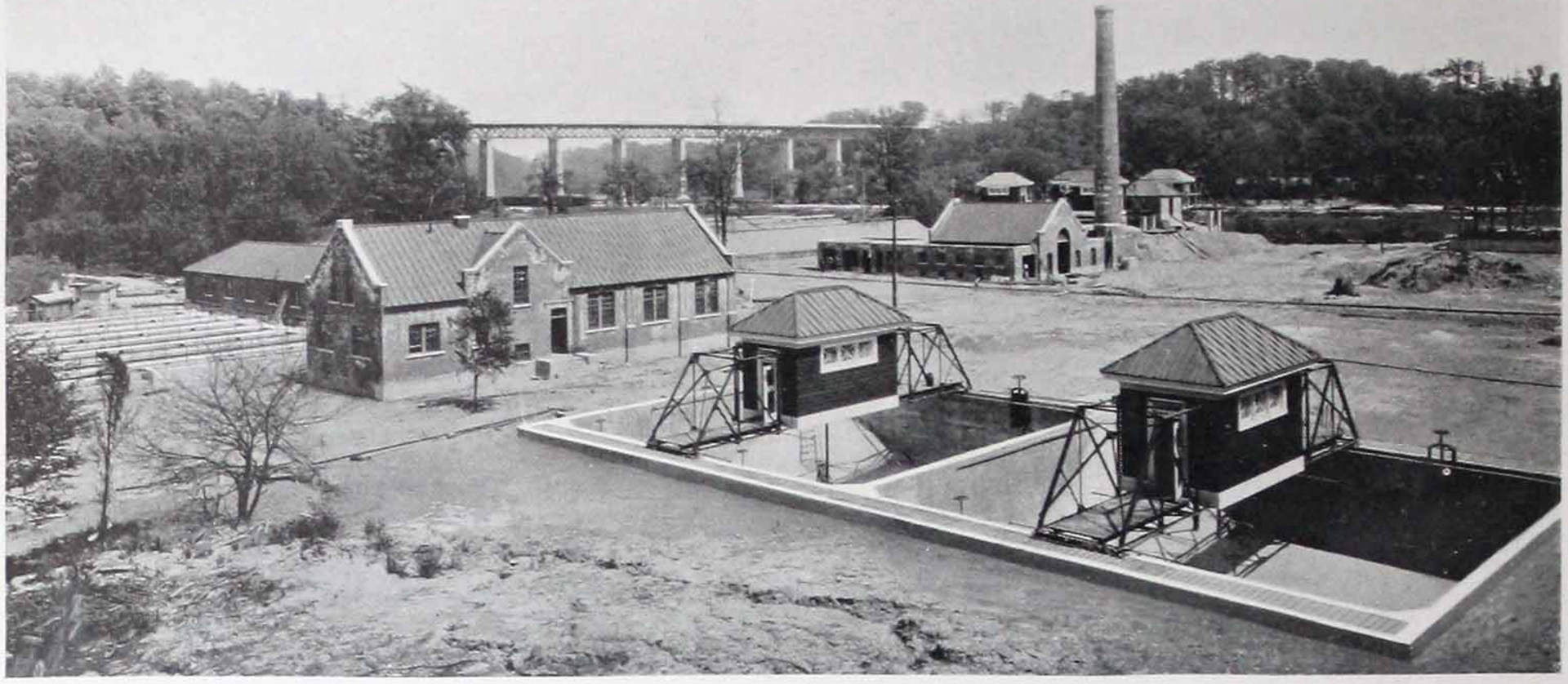


Cold weather does not interfere with the operation of Dorr Traction Clarifiers as shown by this photo of the Clarifier in the sewage treatment plant at Regina, Sask.

The unsatisfactory results obtained in hopper bottom and hand-cleaned sedimentation tanks led to the development of the Dorr Clarifier. The successful results produced by the Clarifier are responsible for the fact that Dorr Clarifiers have since been installed in all types of sewage treatment plants, including straight sedimentation, activated sludge, chemical precipitation, separate sludge digestion, Imhoff tank-trickling filters, and lime-electrolytic.

The Dorr Clarifier is a mechanically-cleaned sedimentation unit from which the settled sludge is removed continuously. Its use completely eliminates the troubles caused by septic action in the tank and permits the use of a single, shallow tank which greatly reduces initial plant construction costs. As a matter of fact, in order to utilize gravity and keep down pumping costs, sewage treatment plants are usually located in the lowest land adjoining a municipality. In such places rock and groundwater are often encountered and reduction in construction costs made possible through the use of the Clarifier is often a sizable item.

However, it is in the actual operation of the plant that the Dorr Clarifier presents its greatest advantages. Continuous removal of the sludge means that there is no reduction in Clarifier volume available for settling. Thus a uniformly



These two Dorr Clarifiers are used for sedimentation ahead of aeration in the activated sludge plant at North Toronto, Ont.

clarified effluent, uncontaminated by septic sludge is produced. There is no disagreeable manual handling of the sludge and as the Clarifier is continuous and automatic in operation, only occasional supervision is required.

One of the most interesting applications of Dorr Clarifiers which has come to the fore quite recently is their use as preliminary sedimentation units ahead of further treatment. In such cases a short period of detention in the Clarifier is provided for and only the coarser solids settle out, while the finer slower-settling solids are carried over in the effluent to further treatment. In fact, the trend in modern sanitary engineering practice has been to substitute preliminary sedimentation for fine screening. In the huge North Side activated sludge plant in Chicago, eight large Dorr Clarifiers are used for the presedimentation service.

The Dorr Traction Clarifier, the most recent, improved type, is simple and strong mechanically, extremely attractive in appearance, and noiseless in operation. It is designed to operate for years without the necessity of draining the tank. All bearings and wearing parts are conveniently accessible above the water line. Maintenance costs are low.

The Clarifier mechanism is supported at both ends and its design makes it particularly suitable for plants where grease or floating solids must be skimmed from the tank.

A separate bulletin, which will be forwarded on request, describes more fully the operation of the Traction Clarifier.

Dorr Traction Clarifier, with shimming attachment, in the separate sludge digestion plant at Klamath Falls, Ore. The Dorr Digester can be seen in the background.

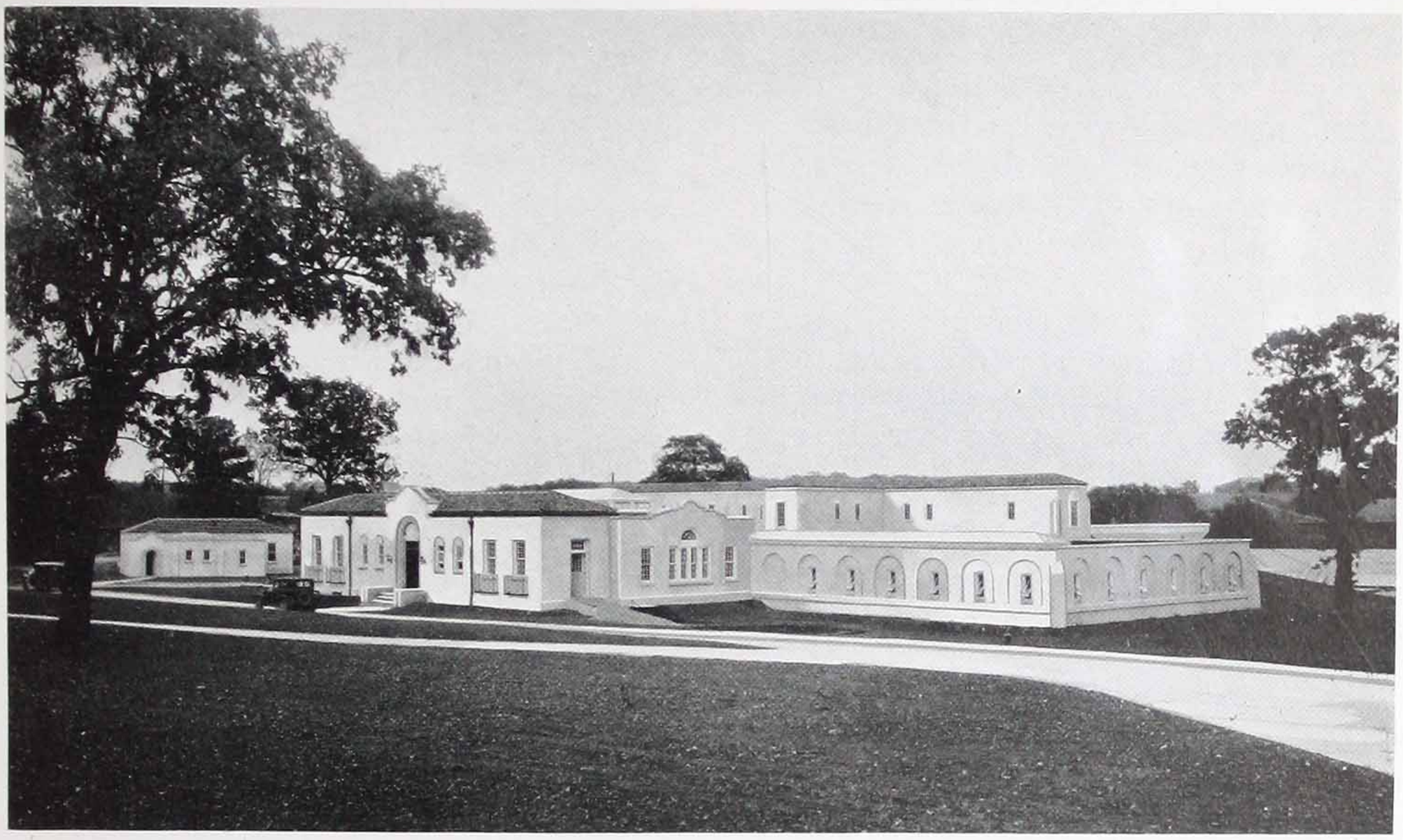
Separate Sludge Digestion

The problem of disposing of the sludge discharged from sedimentation units is naturally one which has been the subject of much study and research.

Digestion of the sludge, that is, its decomposition in the absence of air until the residue is an inoffensive humus of much smaller volume than the raw sludge, has long been recognized as a satisfactory method, providing constant control of the digestion process is feasible.

In the older types of two-story tanks, which provided for sedimentation in the upper compartment and digestion in the lower compartment, such control was virtually impossible and the result was that much trouble was encountered with foaming and scum formation, and with disagreeable odors in the vicinity of the plant. Moreover, in plants of this type deep tanks are required and construction costs are proportionately high. These limitations led to the early experimental work in England and elsewhere with digestion of sludge in a tank entirely separate from the sedimentation unit. Results, at first, while generally an improvement on those produced in two-story tanks were not all that could be desired.

In recent years, however, studies on improved methods of mixing fresh sludge with ripe, digesting sludge, of the influence of the pH concentration on the reaction, and of the utilization of the gas generated by the process for regulating the temperature inside the digestion tank, have brought general recognition of the merits of the separate sludge digestion process.



Separate Sludge Digestion Plant, Sanitary District of Aurora, Ill. In this attractive looking plant all equipment is completely housed. In the small building at the left a Dorrco Bar Screen and Dorr Detritor are installed. Equipment in the main building includes four Dorr Clarifiers and three Dorr Digesters.

The Dorr Company and the Dorr Digester have materially assisted in improving the status of the process. There are at present over 65 plants operating Dorr Digesters for separate sludge di-

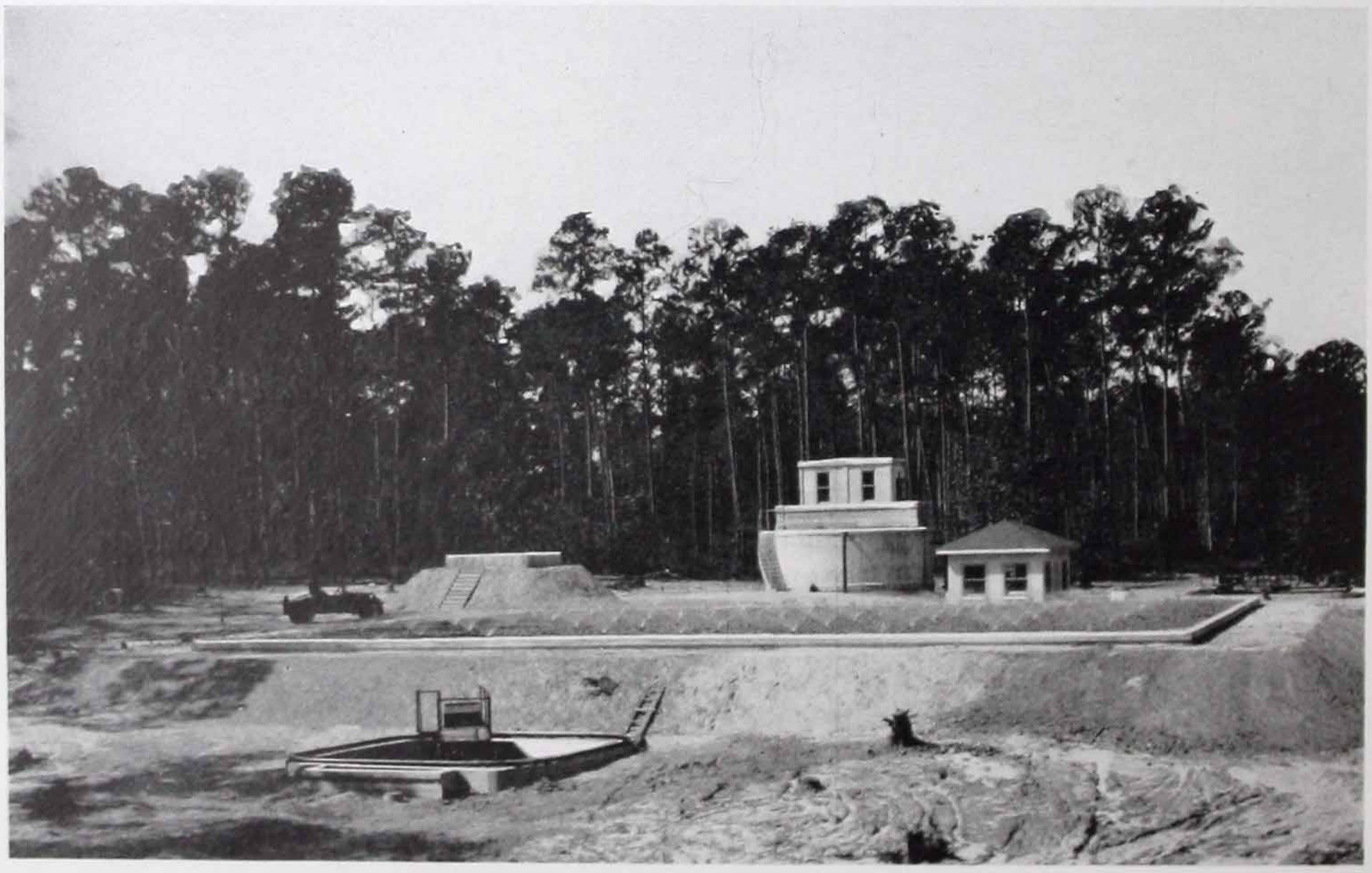
Dorr Digester in the sewage treatment plant at Salem, O. A Dorrco Bar Screen and four Dorr Clarifiers are also in operation at this plant.

gestion. In most of these the Digesters receive raw sludge discharged from Dorr Clarifiers, but, in some cases, they are used in connection with the activated sludge process.

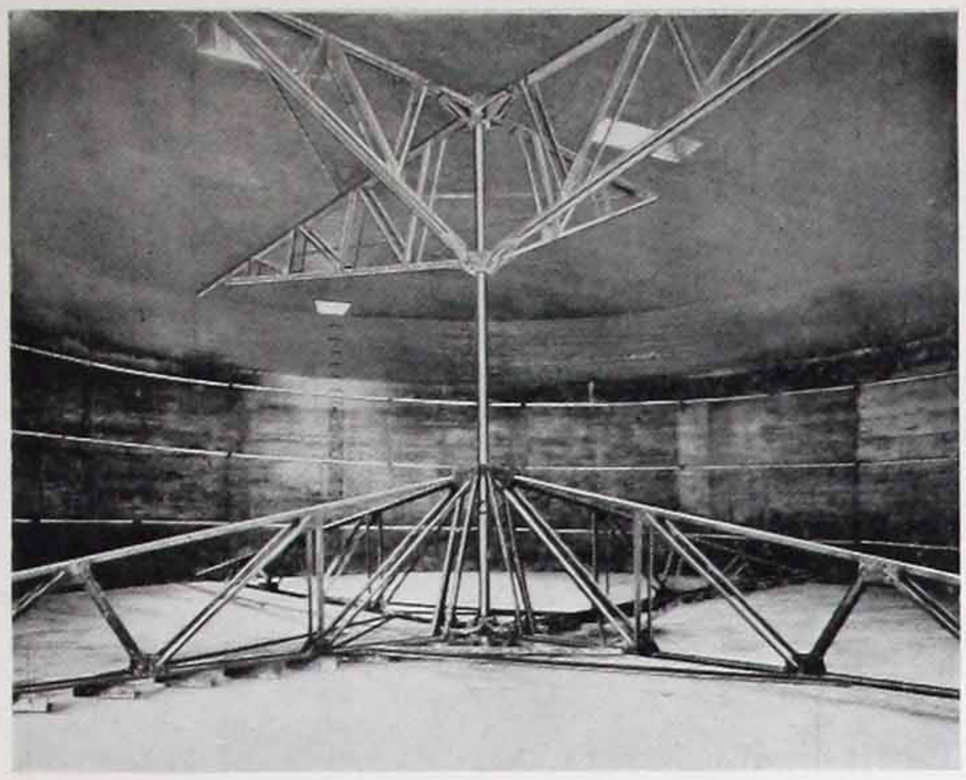
The Digester is a special mechanism designed to improve the distribution of raw sewage solids to digestion tanks, to aid the digestion process therein, and to facilitate discharge of the digested sludge from the tanks. The mechanism, which is supported from a superstructure resting on the tank walls, consists of a central vertical shaft, fitted with two sets or radial arms, one at the bottom and the other near the top of the tank.

As the vertical shaft slowly revolves the lower set of arms keeps the digesting sludge on the tank bottom stirred up, and, when the discharge valve is open, the arms assist in pushing the ripe sludge to the central discharge opening. The upper set of arms keeps the sludge at the top of the tank stirred up, preventing scum formation and allowing free liberation of the gas from the digestion process.

The Digester is usually provided with means for collecting this gas under a pressure sufficient to force it to a desired point of utilization. The method of burning the gas and the arrangement of heating coils are designed to suit local conditions.



Separate sludge digestion plant at Lake City, Fla. The Dorr Traction Clarifier in the foreground is used for sedimentation of the trickling filter effluent. Behind the filters can be seen the Dorr Digester, pump house and primary Clarifier.



Inside view of a Dorr Digester, empty. Note the heating coils around the tank walls. Hot water, heated by gas collected from the Digester, is circulated in the pipes.

The use of Dorr Digesters in separate sludge digestion plants presents many attractive features, prominent among which are:

Complete control of the digestion process is assured as it is entirely isolated from other processes.

Scum formation and frothing are eliminated.

The gases which have fuel value are constantly liberated, collected and burned, thereby providing heat for maintaining optimum digestion conditions and reducing capacity requirements.

There are no obnoxious odors from the digestion of sludge.

Conditioning of sludge, when necessary, is easily accomplished.

Mechanical equipment performs all objectionable manual work in handling scum and sludge.

Recirculation of sludge, if desirable, is readily obtained.

The mechanism exerts a definite thickening action on the sludge, and a sludge of greater density than is otherwise possible is produced.

Low construction costs, as shallow tanks and simple concrete form work are used.

The Dorr Digester is fully described in our bulletin No. 6691.

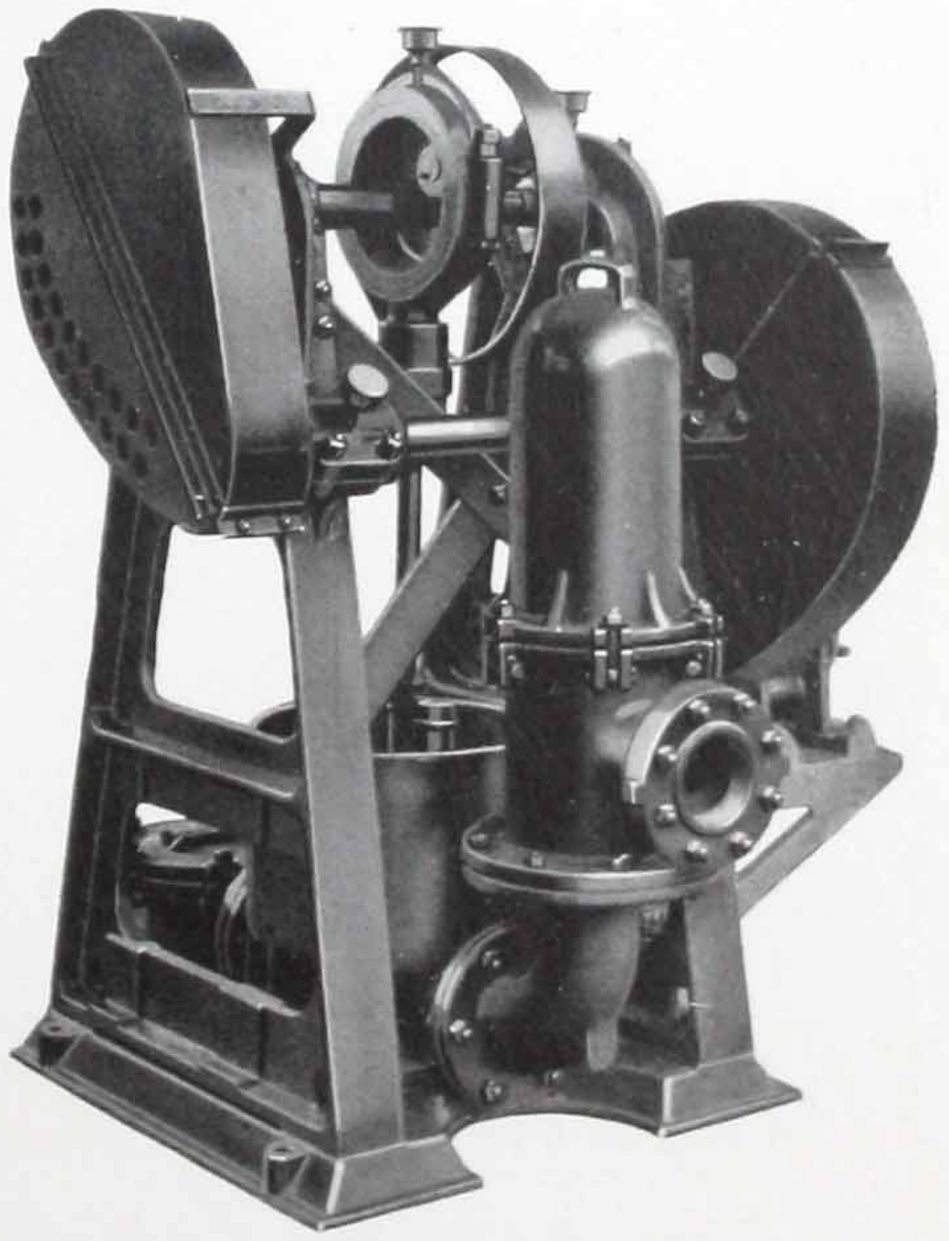
Sludge Handling

The Dorrco Pressure Pump is especially adapted to service in sewage plants for pumping the sludge removed from sedimentation units. It combines two unusual features in that it will handle lumpy, stringy materials and will also work against pressure heads of from 30 to 40 feet. It can be used advantageously where the point of sludge discharge is some distance away from the plant.

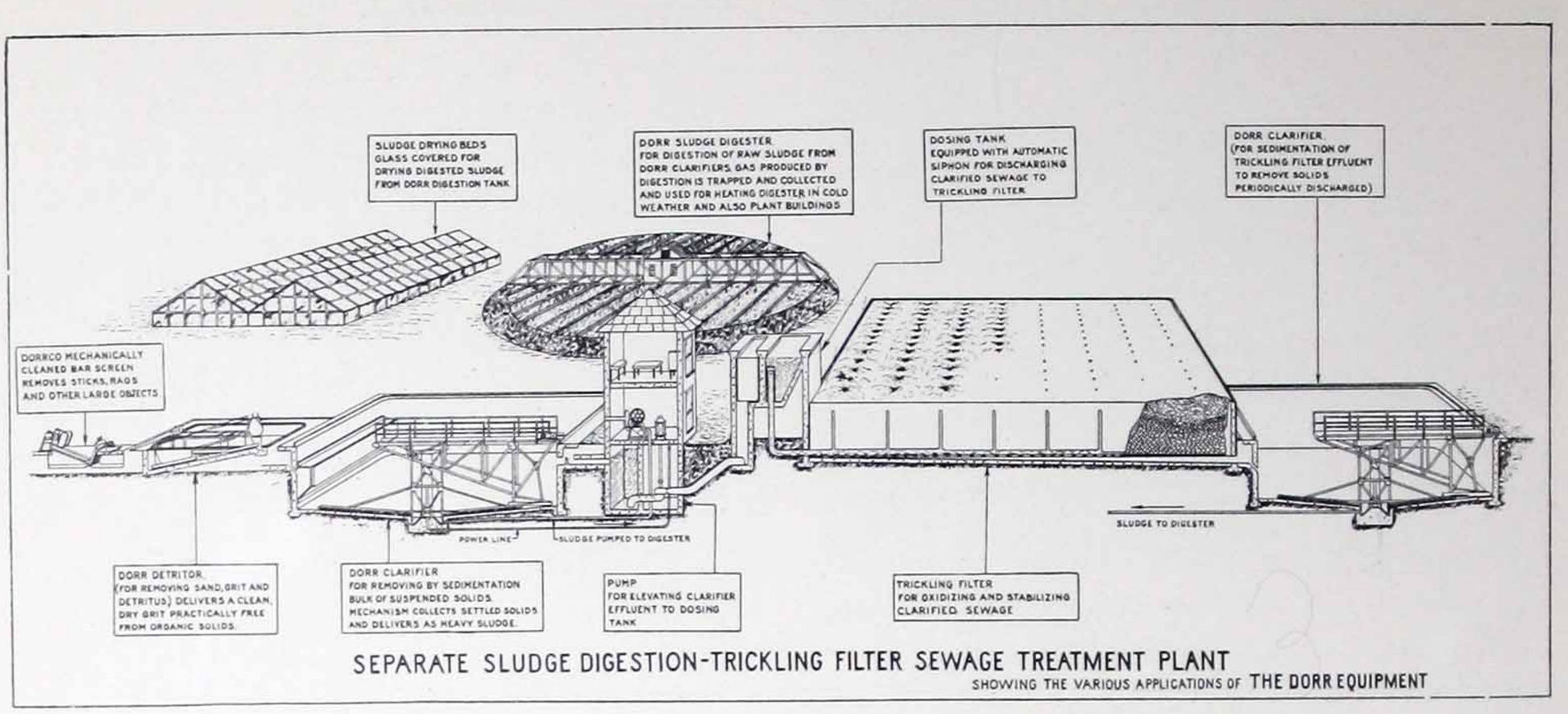
The Dorr Company is also prepared to furnish pneumatic sludge or screenings ejectors which are used for carrying the solids discharged by fine screens to the point of disposal.

When it is necessary to dewater sludge before final disposal the Dorrco Filter offers unusual advantages.

Specific bulletins dealing with Dorrco Pumps and Dorrco Filters give full details of the construction and operation of these machines.

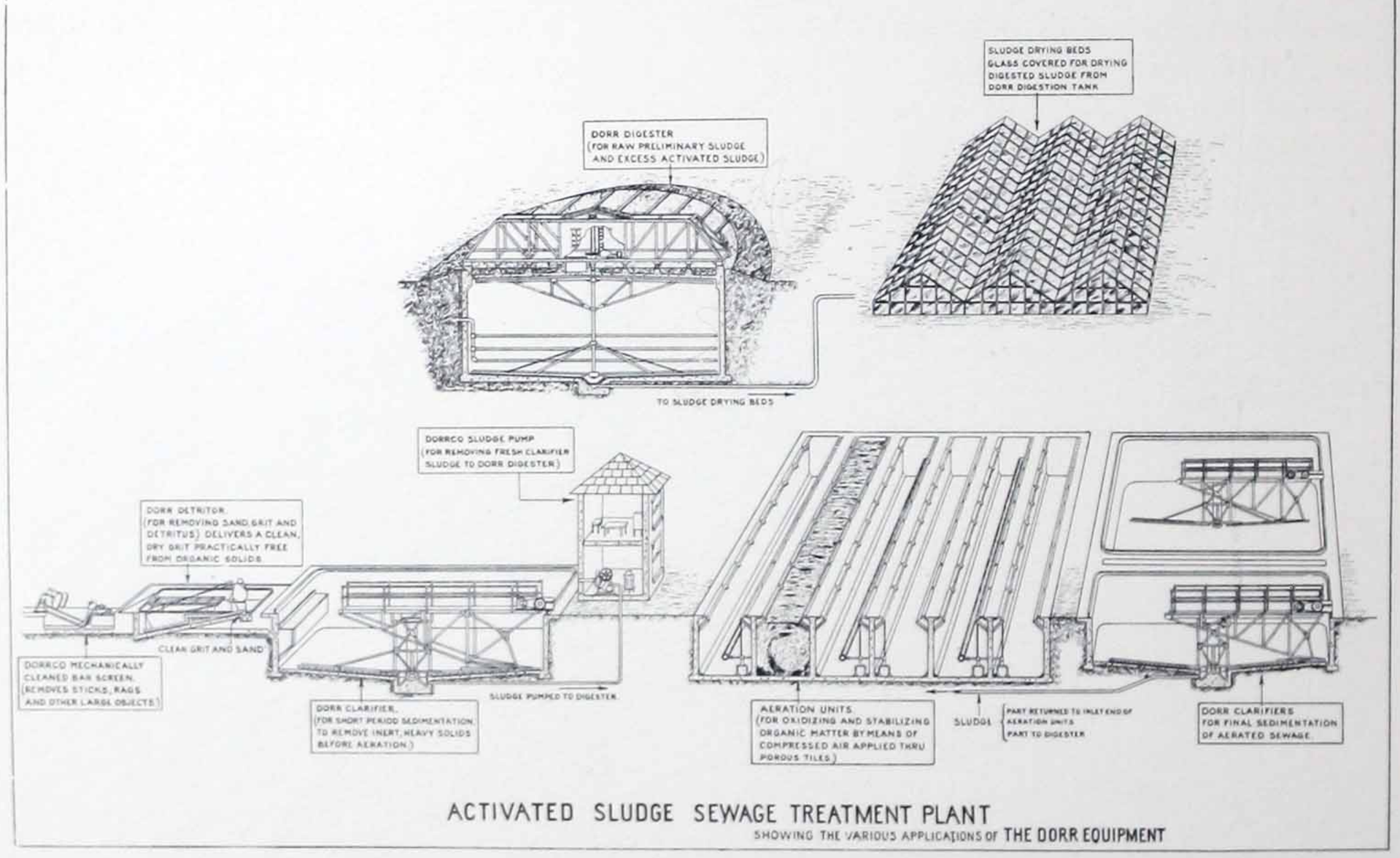


Dorrco Sludge Pump (simplex)



SEPARATE SLUDGE DIGESTION-TRICKLING FILTER SEWAGE TREATMENT PLANT

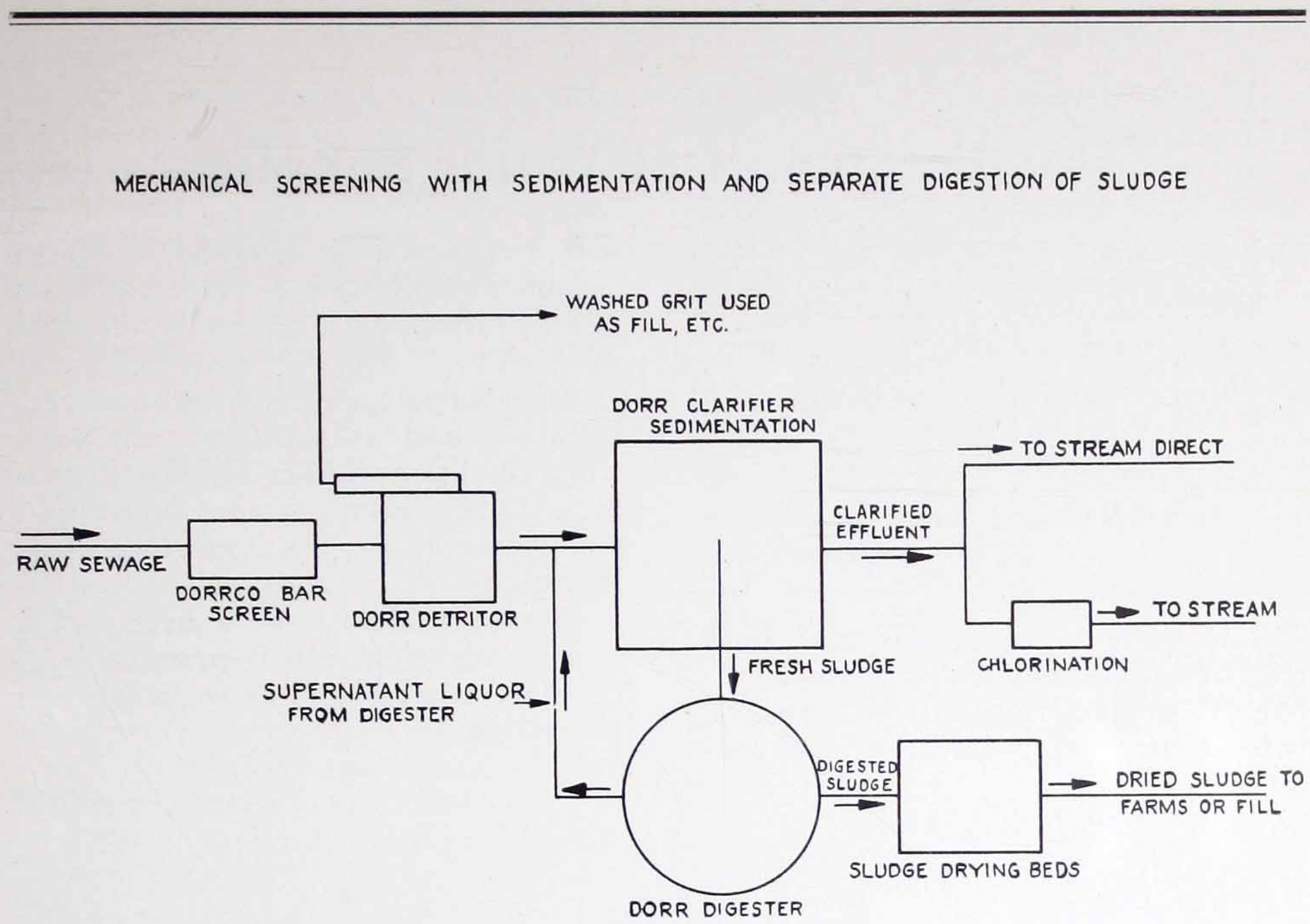
SHOWING THE VARIOUS APPLICATIONS OF THE DORR EQUIPMENT

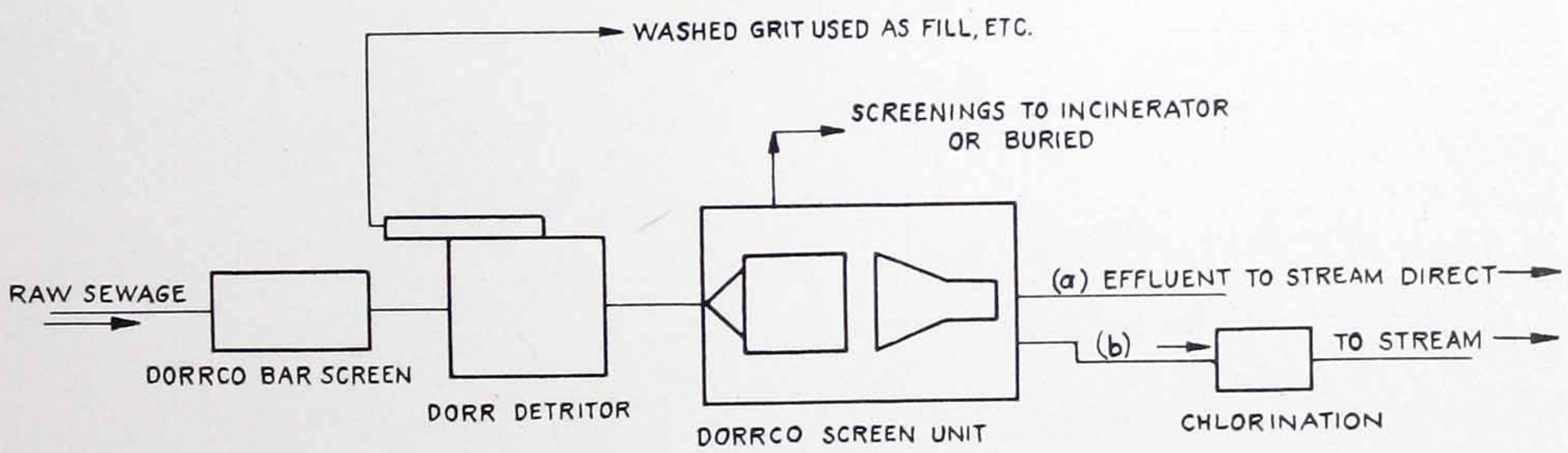


ACTIVATED SLUDGE SEWAGE TREATMENT PLANT

SHOWING THE VARIOUS APPLICATIONS OF THE DORR EQUIPMENT

Typical flow-sheets used in modern sewage treatment plants.





Diagrammatic illustrations of two more representative flow-sheets.

The Treatment of Water Supplies

Introduction

Municipal water purification problems may be divided into two classes:

(a) Those involving the removal of matter in suspension.

(b) Those involving the removal of impurities in solution.

The same classifications also hold true for industrial water purification, but the degree of treatment required will naturally vary with the local conditions.

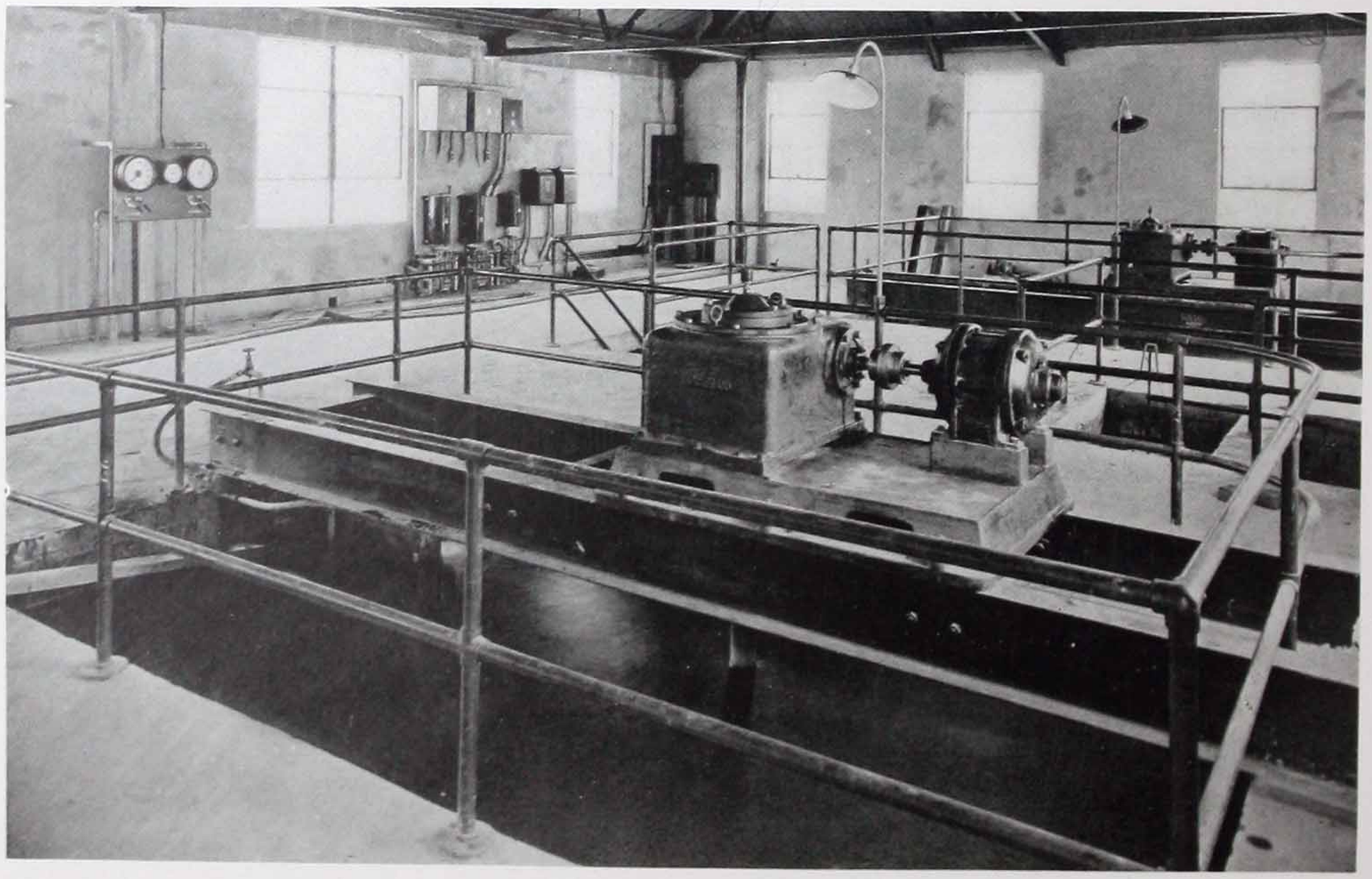
In treating turbid waters or any waters falling within the first class, sedimentation followed by filtration is the usual method of treatment employed. In treating waters of the second class, involving such operations as softening and iron removal, chemical treatment followed by sedimentation and filtration is the generally accepted method.

Accessory steps such as aeration, carbonation and chlorination are used when conditions demand it, but, in general, it may be said that sedimentation and filtration are the important steps in most water treatment plants.

Dorr Clarifiers have been installed as sedimentation units in practically all of the recently built water treatment plants. In addition, other Dorr units have been developed to perform some of the accessory operations commonly met with in water purification work.

Screening

It is usual practice to install a bar screen at the intake to water treatment



Two Dorr Mixers in the water treatment plant at Mamaroneck, N. Y.

plants. These screens catch sticks, rags, and other coarse solids and protect the pumps from damage.

For this purpose the Dorrco Bar Screen offers all the advantages of continuous, mechanically-cleaned operation, combined with low upkeep costs and freedom from mechanical troubles.

Mixing

When it is necessary to introduce lime, alum, iron sulphate or other chemicals into water supplies, it is extremely important to mix them intimately and uniformly with the water. It is necessary, moreover, to provide just the right degree of agitation, as if this is too violent the flocs will be broken up and a slow settling precipitate produced, and, if not sufficiently vigorous, mixing will not be uniform.

Mixing channels, with "over and under" or "around the end" baffles, and various types of paddle agitators have been used for this service. However, these presented certain difficulties that made the development of some more efficient mixing device seem desirable.

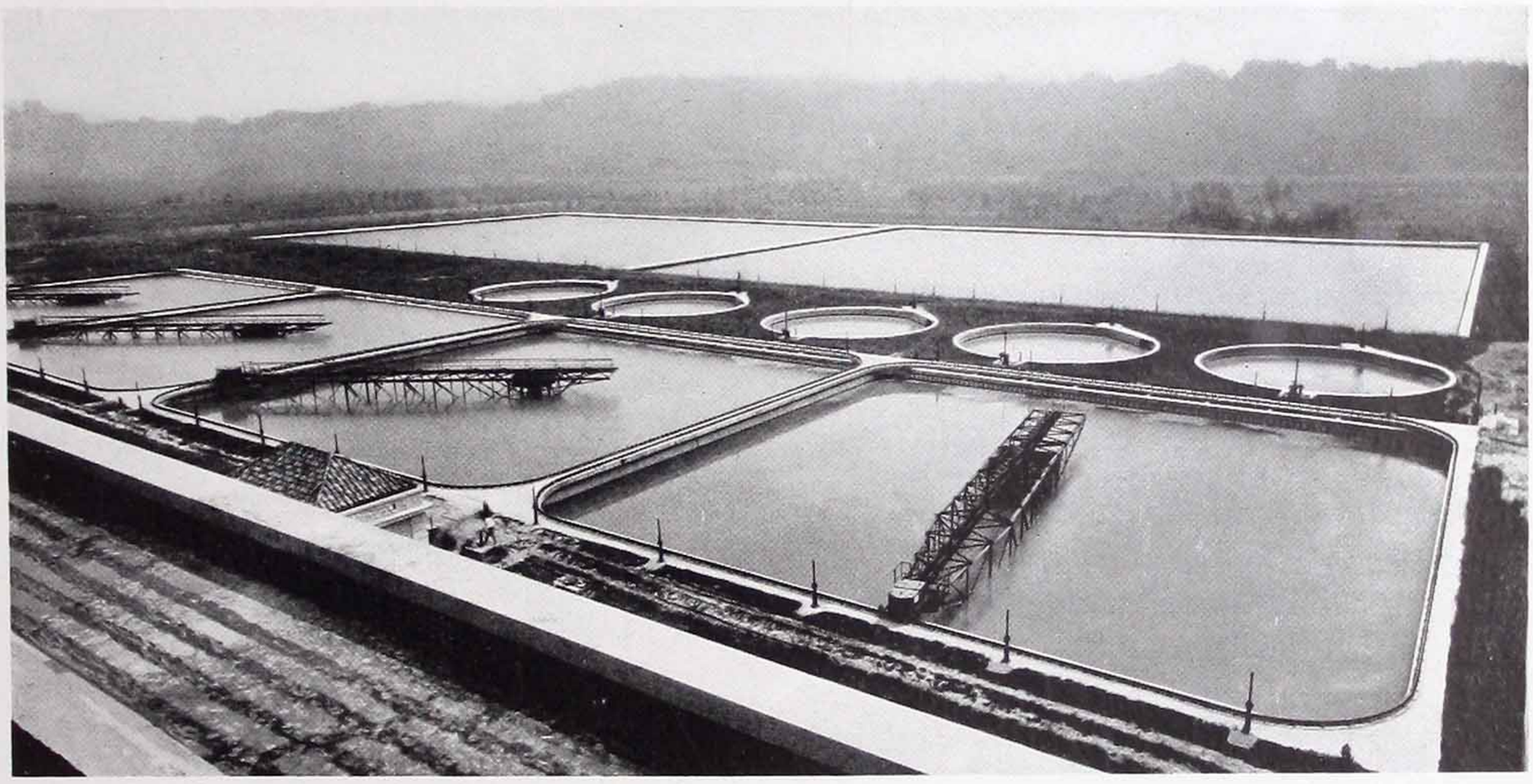
The Dorr Mixer, operating on the impeller-draft tube principle, is especially applicable to water treatment plants whenever it is necessary to mix chemicals with the water. It provides a thorough but gentle agitation that builds up large, quick-settling flocs.

Sedimentation

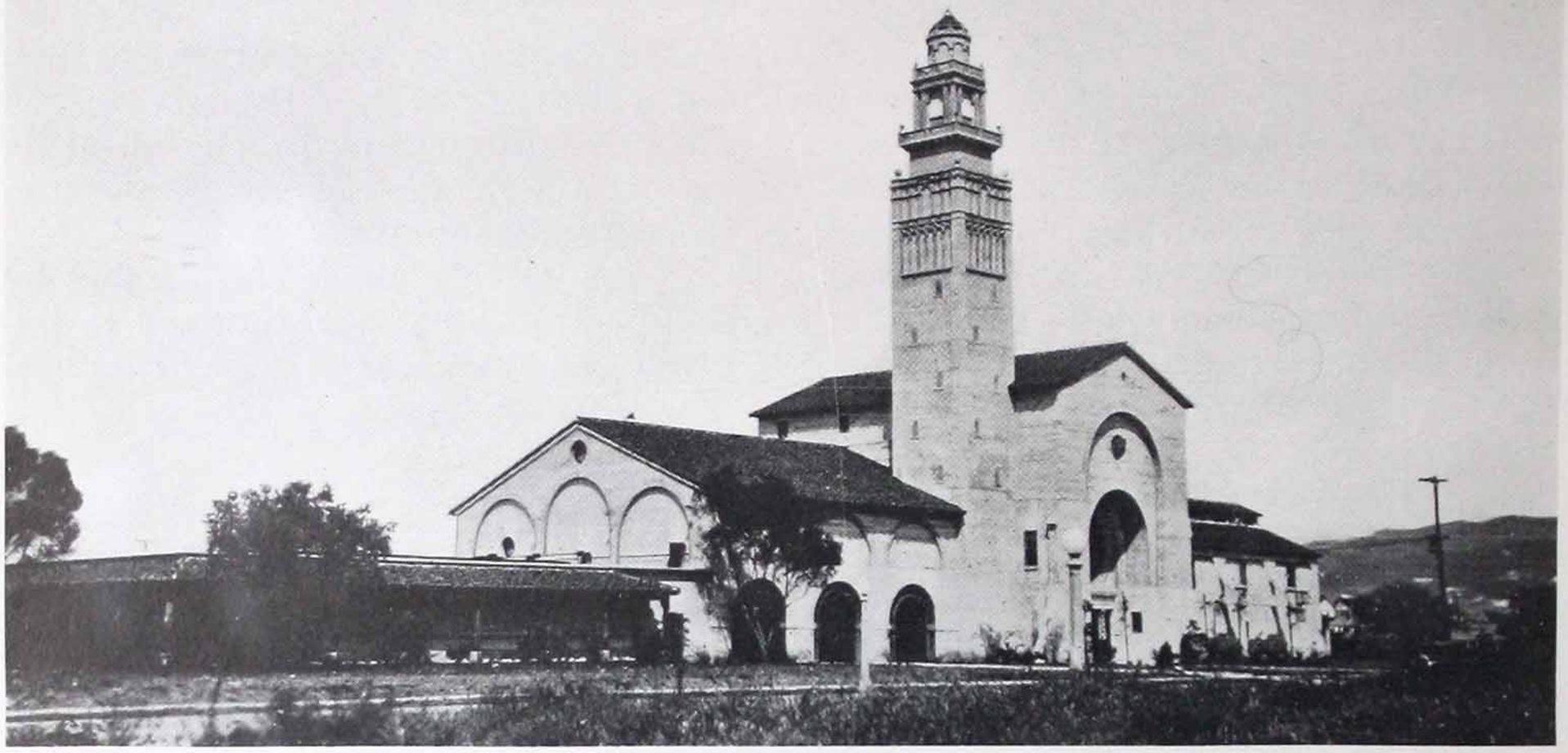
Sedimentation, whether of raw turbid waters, or waters treated chemically for softening or iron removal, is an extremely important operation in water treatment work.

From earliest times clarification by sedimentation has been utilized to improve the character of water supplies. The earliest types of sedimentation basins were operated on the fill and draw principle—that is, the basins were filled, the solid matter in suspension was allowed to settle out, and the clarified water was decanted. This process was repeated until the accumulation of solids made it necessary to clean the basins out and start afresh.

In later years the continuous flow principle has been used. Long and deep basins were constructed, of sufficient volume to allow the solids to settle out



Four Dorr Traction Clarifiers in the Missouri River water treatment plant at St. Louis, Mo.



Water softening plant at Beverly Hills, Cal. A Dorr Traction Clarifier is used for sedimentation of the chemically treated water.

while the water flowed through them continuously. These were kept in operation until the amount of sludge in the tank became excessive and they were then shut down and cleaned out, while a duplicate basin was put into service.

The greatest drawback to plain sedimentation basins is the costly and laborious process of removing the sludge. At some plants teams and scrapers have even been employed. And, in addition to heavy labor charges, the cost of the water used in flushing out basins is considerable.

Dorr Clarifiers have effectively solved this sludge removal problem in modern water treatment plants. The Clarifiers continuously remove sludge from the basins as it is deposited, thus assuring a uniformity of plant operation not obtainable with plain basins.

In general, Dorr Clarifiers offer the following advantages in any type of water treatment plant where sedimentation is employed:

There is no necessity for providing excess storage space for sludge in the basins. Smaller tanks, always working with 100% settling volume, can be used and plant construction costs are proportionately lower.

Duplicate units—one in use while the other is being cleaned out—are not required, as the Clarifier discharges the sludge without the necessity of draining the basin.

There is no chance for organic material in the sludge to become septic, rise to the surface, and contaminate the clarified water.

The cost of operating Clarifiers is much lower than that of labor and water used in cleaning plain sedimentation basins.

The Clarifier discharges a thick, dense sludge. This fact, taken with the fact that no water is wasted in cleaning out the tanks, means greatly reduced water losses.

The continuous discharge of a small quantity of sludge reduces to a minimum pollution of waterways, adjacent to the plant. The intermittent cleaning of plain basins, when sludge discharge is concentrated, discolors streams for many weeks.

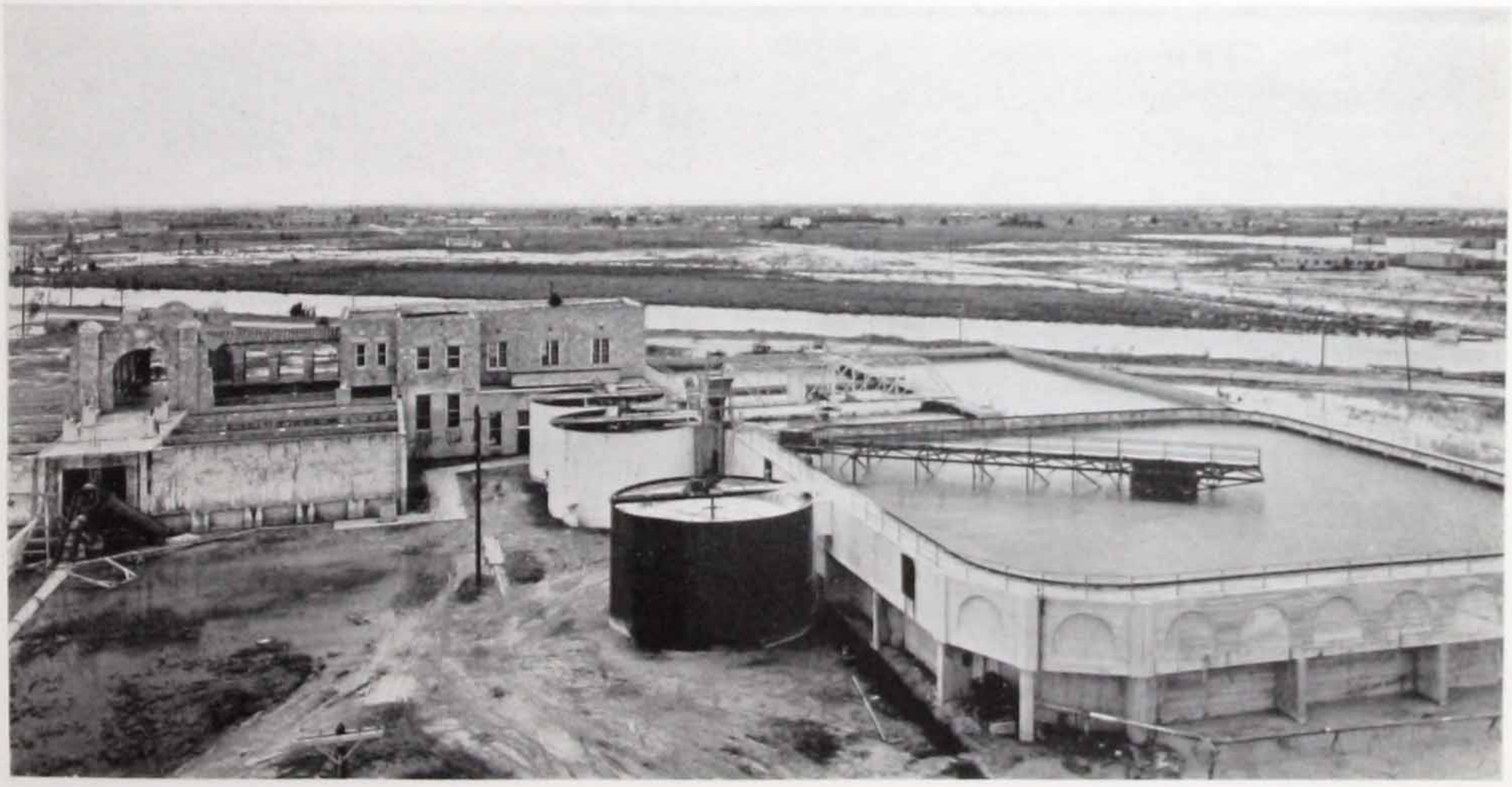
When used in plants treating turbid waters, such as are found in Arkansas, Missouri and states in the Missouri River Valley, Dorr Clarifiers have very definitely proven their worth as presedimentation units. The removal of the bulk of the solids before chemical coagulation not only greatly reduces the amount of chemicals required, but it also results in smoother plant operation all around. At St. Louis, Mo., Dorr Clarifiers are used for presedimentation and also for secondary sedimentation after coagulation.

When used to remove the precipitated sludge from chemically-treated water, both in softening and in iron removal plants, Dorr Clarifiers offer all the advantages listed above and in addition they provide for return of sludge to the mixing basins. It has been found in practice that if part of the sludge discharged from the Clarifier is returned to the mixing basins, the amount of fresh chemicals required can be reduced by as much as 50%.

The Dorr Traction Clarifier, which is the most recent improved type, is a trim-appearing machine, simple and noiseless in operation. Its operation and construction are fully described in a separate booklet.

Sludge Handling

The Dorrco Pressure Pump is especially useful in plants where it is desired to recirculate a portion of the sludge, or where the point of sludge discharge is located at some distance from the plant. The pump is of the diaphragm type, and is of unique design in that it is capable of working against pressure heads of around 20-lbs. per square inch.



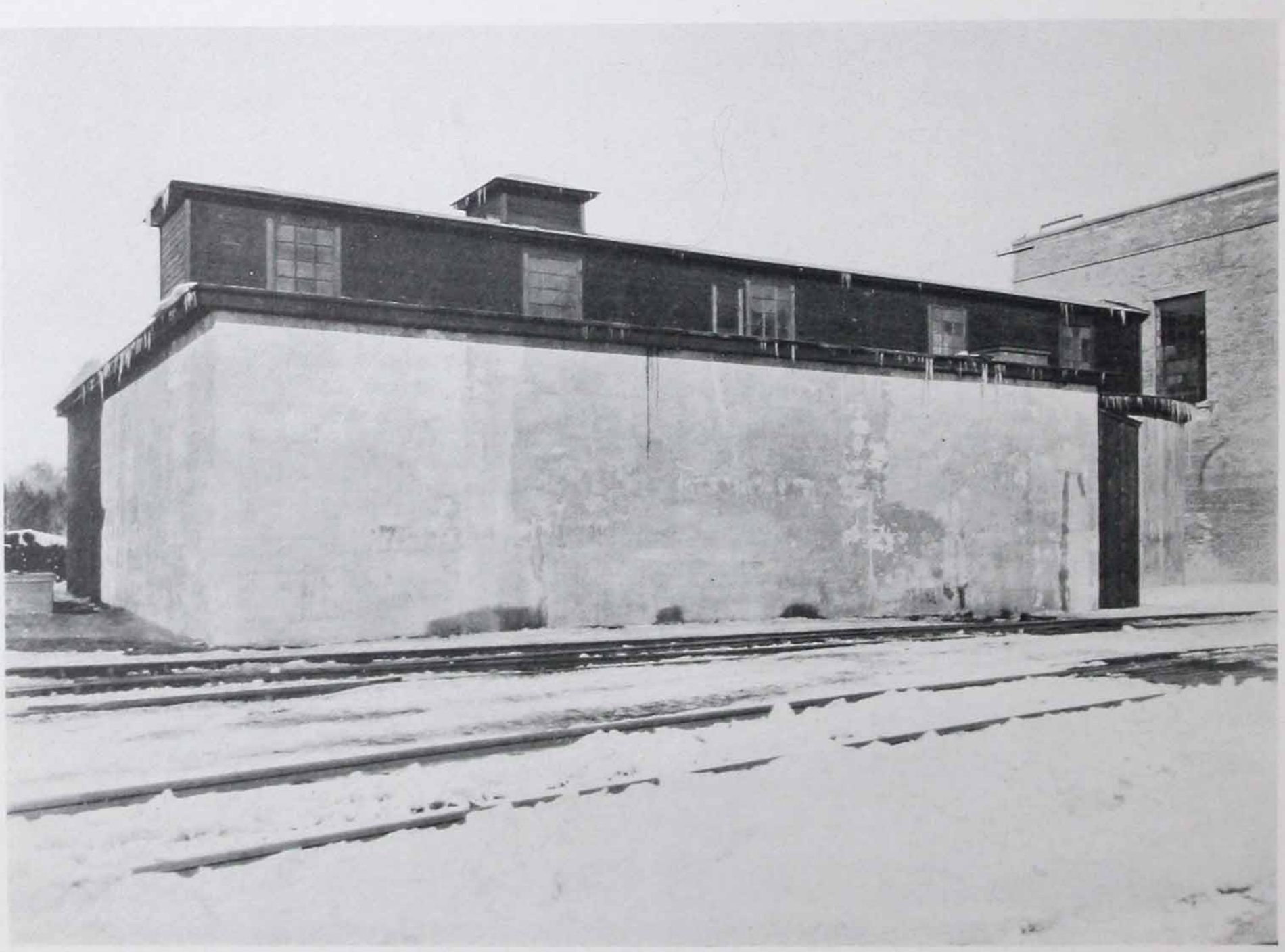
Water tratement plant at Miami, Fla. In the foreground is a Dorr Traction Clarifier. Behind this may be seen an older type Dorr Clarifier that was put in when the plant was first built. The Traction Clarifier was added later.

Industrial Water Treatment

Many industrial plants have water treatment problems quite similar to those of municipalities, although the degree of purity of the finished water is not usually required to be so high. Whereas in municipal plants the water must be rendered safe and inviting to human consumption, in industrial work elimination of scale or sediment in the boilers or condensers, or prevention of discoloration or imperfections in the product during processing, are usually the limiting factors.

Dorr Equipment offers the same advantages to manufacturers having a water treatment problem as it does in the municipal field. The unit sizes will usually be smaller in industrial work, and treatment plants can be designed to handle flows of any size—large or small. The Dorr Company has had a broad experience with industrial water treatment problems, involving removal of turbidity caused by mud, ashes and grit, softening, and iron or sulphate removal.

The facilities of our testing laboratories and the experience of our engineering staff are available to assist manufacturers and consulting engineers who have any type of water treatment problem under consideration.



A Dorr Clarifier used for treating water by the Northwest Paper Co., Cloquet, Minn.

The Treatment of Industrial Wastes

Introduction

Industrial wastes, the liquid discharge from manufacturing plants, present one of the most serious sources of stream pollution. The common practice of discharging these wastes into the most convenient watercourse has given rise to many complaints; and state and municipal health agencies are taking steps to either compel the discontinuance of the discharge of these wastes into streams or require the treatment of them to produce a satisfactory effluent.

As industrial wastes are a natural product of many manufacturing processes, it would be imposing an undue financial burden on the manufacturer to compel him to cease discharging into a stream entirely; therefore, treatment becomes the most logical step.

Differences in processes, character of water, etc., make it necessary to investigate every industrial waste problem individually, and to make the necessary tests upon samples of the particular waste to determine the best and cheapest way to treat it.

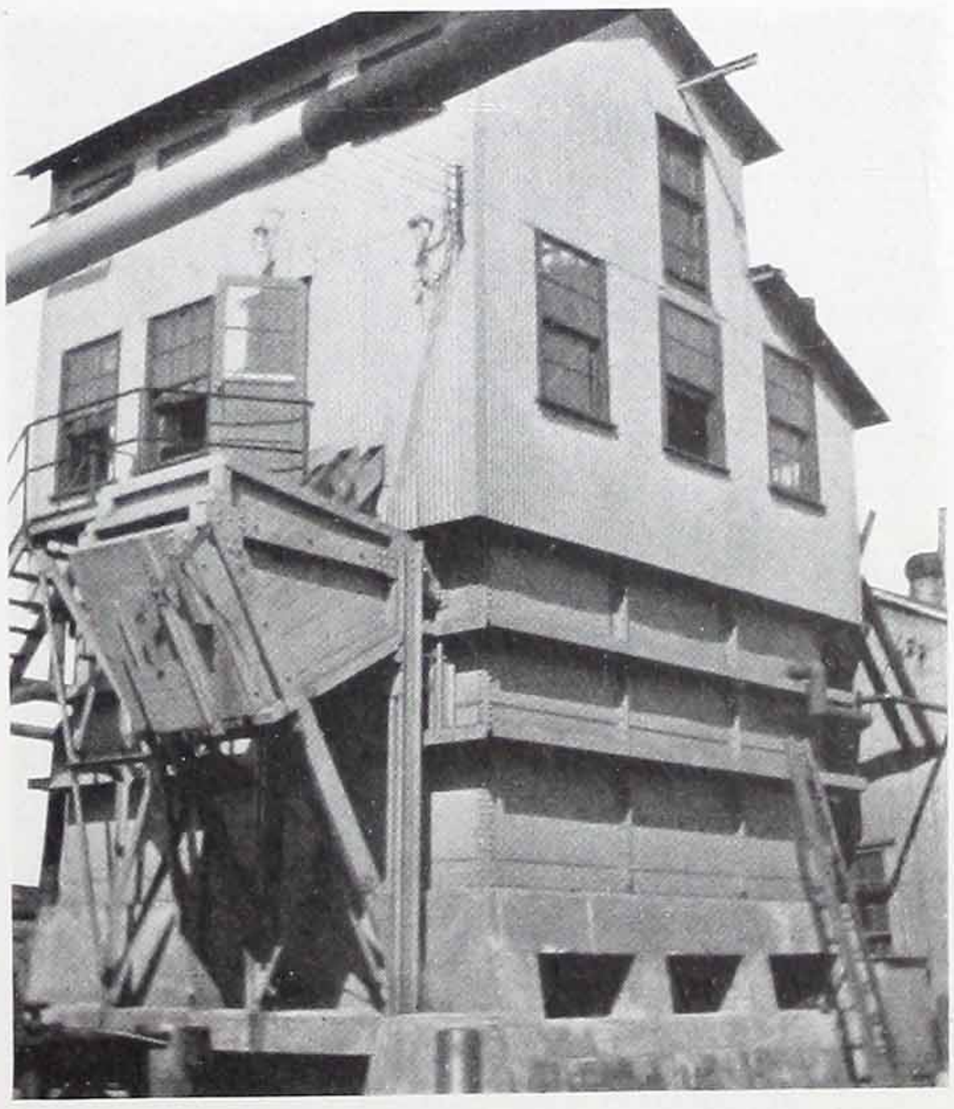
Pollution by industrial wastes is of three kinds, as indicated, and it is possible to have a waste which is polluting in one or all of three possible ways.

1. Color.
2. Poisonous or deleterious substances, causing illness and discomfort to animals and human beings.
3. Deposits: Putrescent or obstructional, causing odors or obstacles to navigation and commerce.

Certain wastes, although high in color, are not dangerous in themselves, but, on the other hand, if they contain chlorine or chlorine derivatives, they are actually beneficial in destroying pathogenic organisms existing in a water supply.

The removal of any one or all of the objectionable contents is a problem which although varying in the degree of difficulty of solution, can usually be solved reasonably economically and entirely satisfactorily. Methods of treatment of wastes from the following industries have been successfully developed by the Dorr Company, and plants have been installed in which the investigational work has been applied on a working scale and demonstrated to be practical and economical.

Tanneries
Canneries
Packing Houses (Meat)
Milk Products Factories
Textile Mills
Dye Factories
Iron and Steel Mills



Waste treatment plant of the Brooklyn Union Gas Company, Brooklyn, N. Y. This photo shows how industrial waste treatment plants can be completely enclosed.

Paper Mills
Rubber Reclaiming Plants
Roofing Manufacturing
Asbestos Manufacturing
Gas Plants
Oil Refineries
Glue and Gelatine Factories
Cornstarch
Coal Washeries
Mines

We maintain a staff of trained engineers and chemists and a completely equipped laboratory and testing plant, and are prepared to co-operate with manufacturers and engineers in developing a method of treatment for any industrial waste.

Our service includes a thorough investigation of the problem; testing of sample of the waste; development of a method of treatment; a layout of the equipment required, such as Dorr units, chemical feeding devices, pumps, regulating devices, etc.; and engineering service in connection with the setting up and starting of the plant.

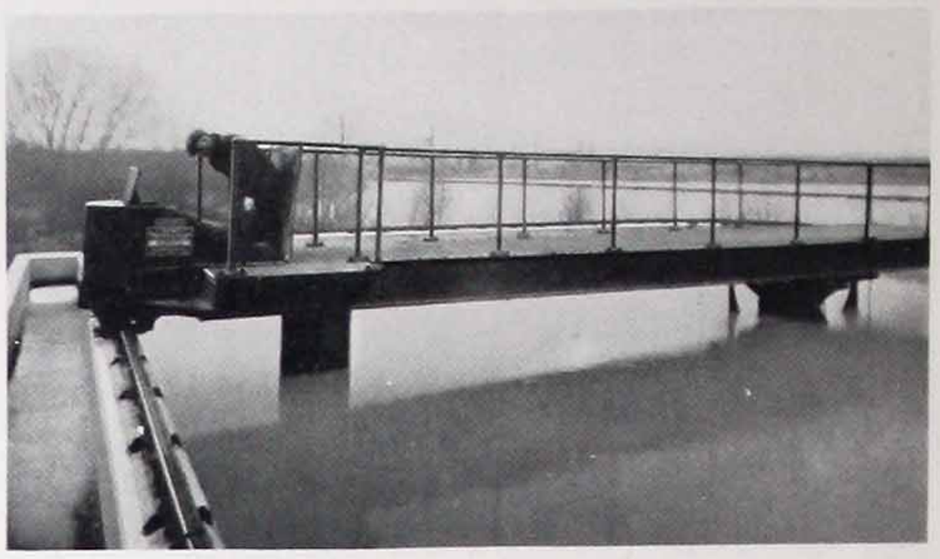
Screening

Many industrial wastes carry large quantities of fairly coarse solids which must be removed before the waste can be discharged into nearby waterways, or before more intensive treatment, when the latter is required. Among wastes of this character are those of tanneries, canneries, glue and gelatine factories, and meat packing plants.

For treating wastes of this kind the Dorrco Screen unit has proven extremely successful.

Sedimentation

Where a more intensive treatment than screening is required, sedimentation, with or without chemical precipitation, is usually employed. In such cases, Dorr Clarifiers present the logical means of carrying out the sedimentation step and there are numerous installations of Clarifier units satisfactorily handling industrial wastes of the types listed above.



A Dorr Traction Clarifier in the waste treatment plant of the Arkwright Corporation, Fall River, Mass.

Mixing

It is quite often found, particularly when color is the polluting factor, that some form of chemical precipitation must be resorted to, previous to sedimentation. Typical wastes of this character are those produced by dyeing, bleaching, and finishing plants.

The Dorr Mixer is particularly suited to the operation of mixing the chemicals with the waste. The Mixer gives that uniform, gentle agitation producing a dense, quick-settling precipitate, which is so desirable if best results are to be obtained in the sedimentation unit that follows.

Sludge Pumping

As in the case of municipal sewage, sludges produced in industrial waste Dorrco pressure pumps are particularly adapted to the work of handling treatment plants. It is usually necessary to pump the sludge to a point some distance from the plant and the Dorrco Pressure Pump is capable of doing this, or of lifting the sludge to a higher elevation, at an extremely low cost for power and maintenance.

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Atlanta, Ga. . . . . 1503 Candler Bldg.

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